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NOVEMBER
1960

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING

COLOR IN LIGHTING

A special report, in full color, on the principles and practices of the use of color in lighting application.

— page 103

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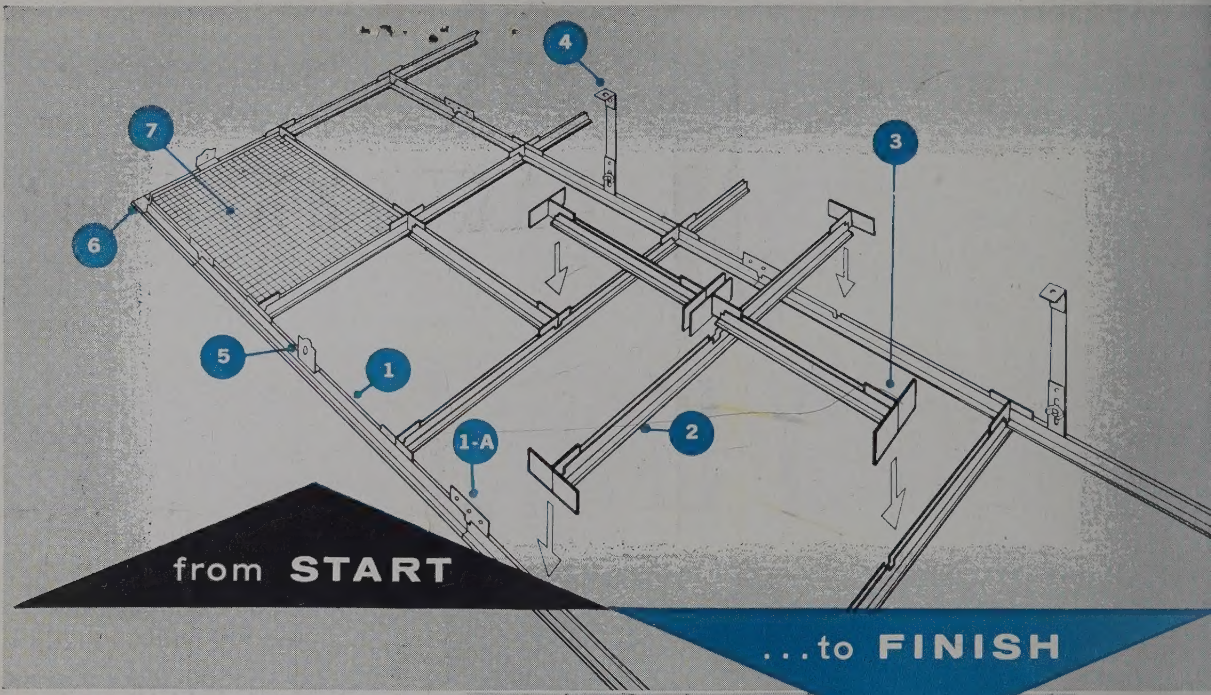

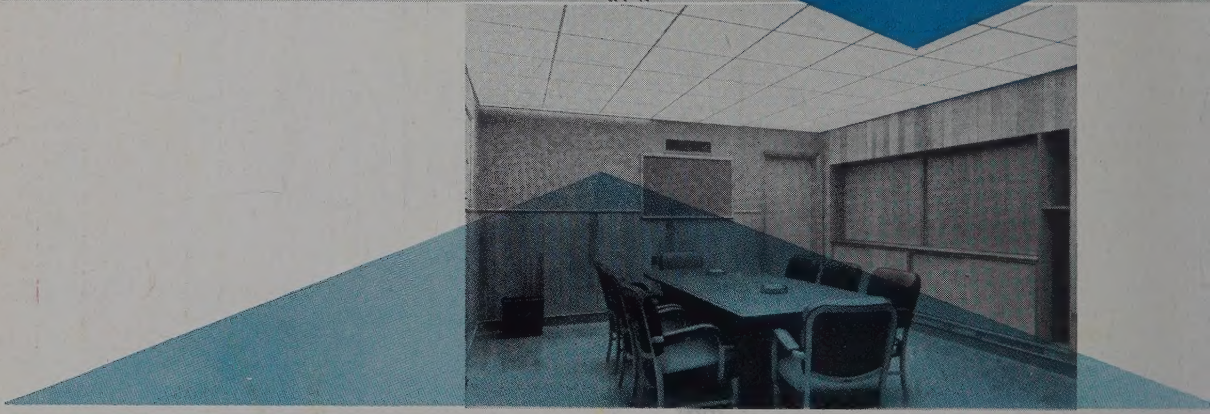

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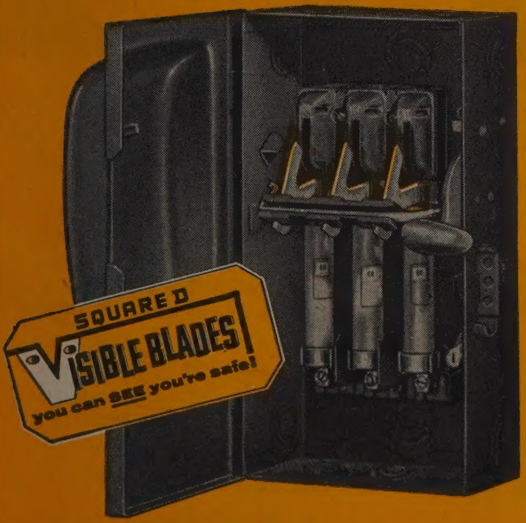

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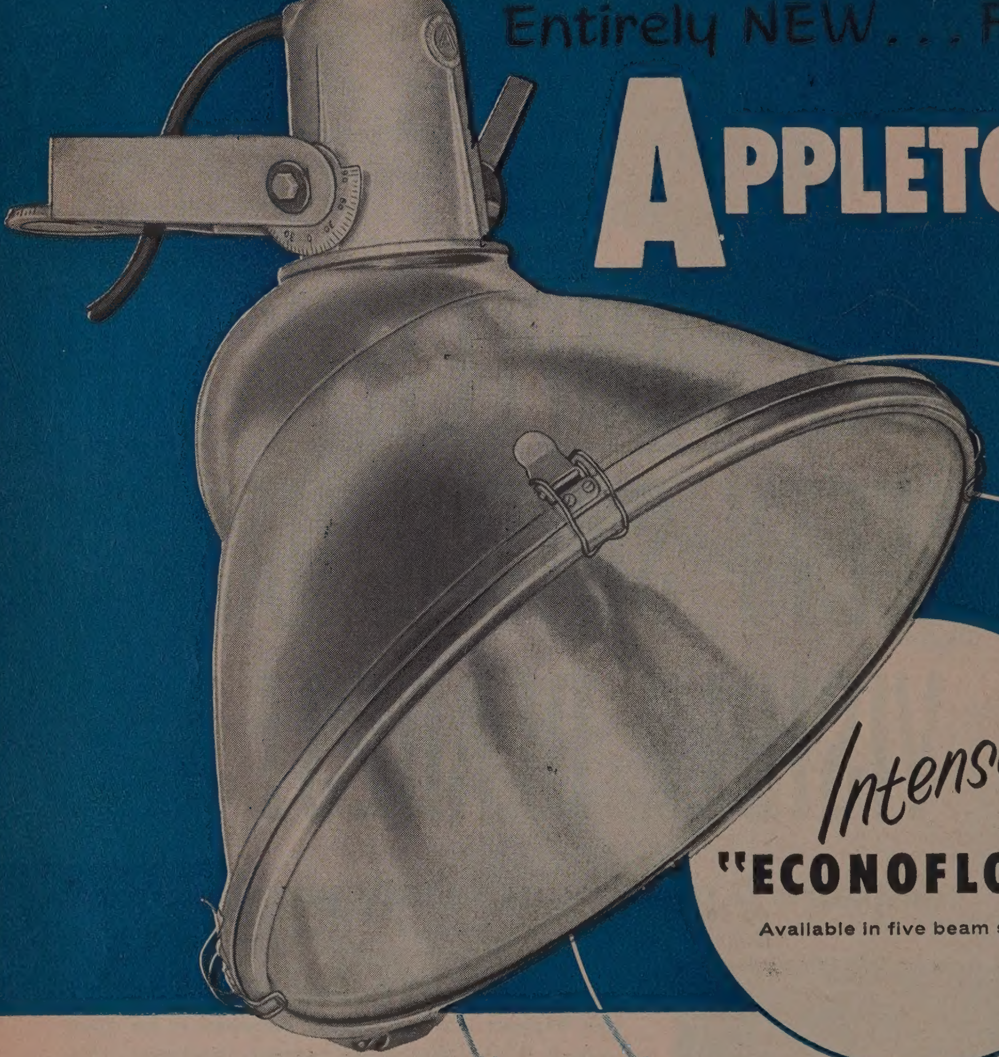

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Published for electrical contractors, electrical departments in industry, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management in the field of electrical construction and maintenance.

60TH YEAR • NOVEMBER 1960

Sidelights 7

Washington Report 9

Color, a new Dimension in Lighting, *An Editorial* 79

480/277 Volts in an Office Building 81
By J. F. McPARTLAND—A close look at the modern electrical installation serving light and power loads in Pittsburgh's Gateway No. 4.

Modern Methods Speed Underground Duct Work 86
Streamlined materials handling techniques accelerate installation of multi-tier banks of fiber conduits at Chicago's International Airport.

Estimating Forum—VI 89
By RAY ASHLEY—The standard labor unit.

Electrical Features are Hotel Plus Values 90
By JAMES CONNOR—Details on new $6-million hotel in Portland, Ore.

Electric Heating Forum No. 5 94
Sidewalk snow melting; electrical space heating outlook for 1961; infrared spot heating.

All-Electric Residence 100
Residence has two distribution centers related to 16½-kw lighting load plus 220-volt service for cooking, space heating, etc.

Color in Lighting 103
By B. C. COOPER—A comprehensive report on the color characteristics of light, how color quality of light affects vision, and how color in lighting principles can be applied to everyday lighting problems.

- **Physics of Light and Color** 104
- **Floodlighting Rural Factory** 106
- **Light Adds Beauty** 107
- **Color-Contrast Floodlighting** 107

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ELECTRICAL CONSTRUCTION AND MAINTENANCE

NOVEMBER • 1960 *continued*

Distinctive Floodlighting 107
Color-Improved Lighting 108
Filter Diffusers 108
Environment for Dining 108
Color-Balanced Lighting 109
Color in Lighting 109
3-D Realism in Mural 109
Multi-Color Lighting 109
Variable Environments 110
Improve Lighting Quality 110
Expand Decorative Effects 110
Garden Lighting 110

Practical Methods 133

Epoxy jackets protect motor coils; surface wiring expands plant distribution; inclined rack simplifies cable storage and measurement.

Reader Service 153

Product news announcements; catalogs and bulletins.

Reader's Quiz 183

Questions and answers on motor insulation tests; car braking methods; voltage unbalance.

Questions on the Code 197

Answers to code questions on wiring range components; bare copper wire in aluminum conduit; conduit fill derating factors.

In the News 211

Dates Ahead 226

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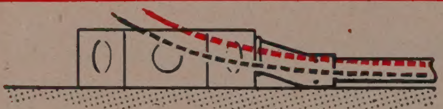
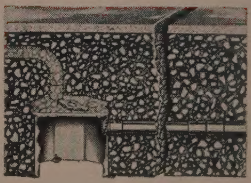


B-M Offset Connector, showing how wires are guided over box edge.

Briegel All Steel Indenter Fittings are U.L. approved as Concrete-Tight.



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Sidelights

COLOR IN LIGHTING

The role of color in vision is such a universal human experience it deserves more critical attention in the design and application of lighting systems. In too many practical installations the effect of lighting on color perception is only incidental to the achievement of other illumination qualities. And the deliberate use of color in lighting needs much wider application. To stimulate industry interest in the color aspect of modern lighting application, we present a special editorial report, "Color in Lighting," by Associate Editor Berlon C. Cooper beginning on page 103.

GATEWAY NO. 4

Another great building in the dynamic modern expansion of downtown Pittsburgh, Pa., is a 22-story office structure in the famous Gateway group. The modern electrical system was designed by Meyer, Strong and Jones of New York City, and executed by Frame Electric Co. of Pittsburgh. The system is a high capacity installation with substantial margins for load growth using selectively coordinated overcurrent devices for system reliability. "480/277 Volts in an Office Building" begins on page 81.

MECHANIZED UNDERGROUND WORK

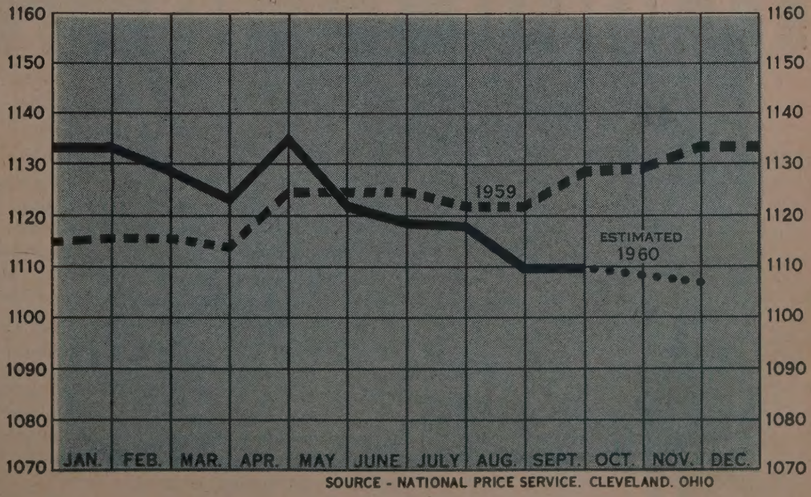
Pre-planned and scheduled materials handling techniques were employed by Main Electric Co., Chicago, in the first segment of the huge underground electrical distribution system which is one phase of the $120 million expansion of facilities at O'Hare Field, Chicago's 7,100-acre International Airport. The installation is described in "Modern Methods Speed Underground Duct Work" beginning on page 86.

MODERN ELECTRICAL HOTEL

The Northwest's newest hotel and one of the most modern electrically in the world has been completed recently in Portland, Ore. It is the newest link in the Sheraton chain. Powered by a busway riser system, the installation incorporates a variety of new lighting schemes and new communication and control systems. The electrical facilities of the new hotel are described by James Connor, job supervisor for electrical contractors Wismer & Becker, Sacramento, Calif., who handled the installation, in "Electrical Features Are Hotel Plus Values" beginning on page 90.

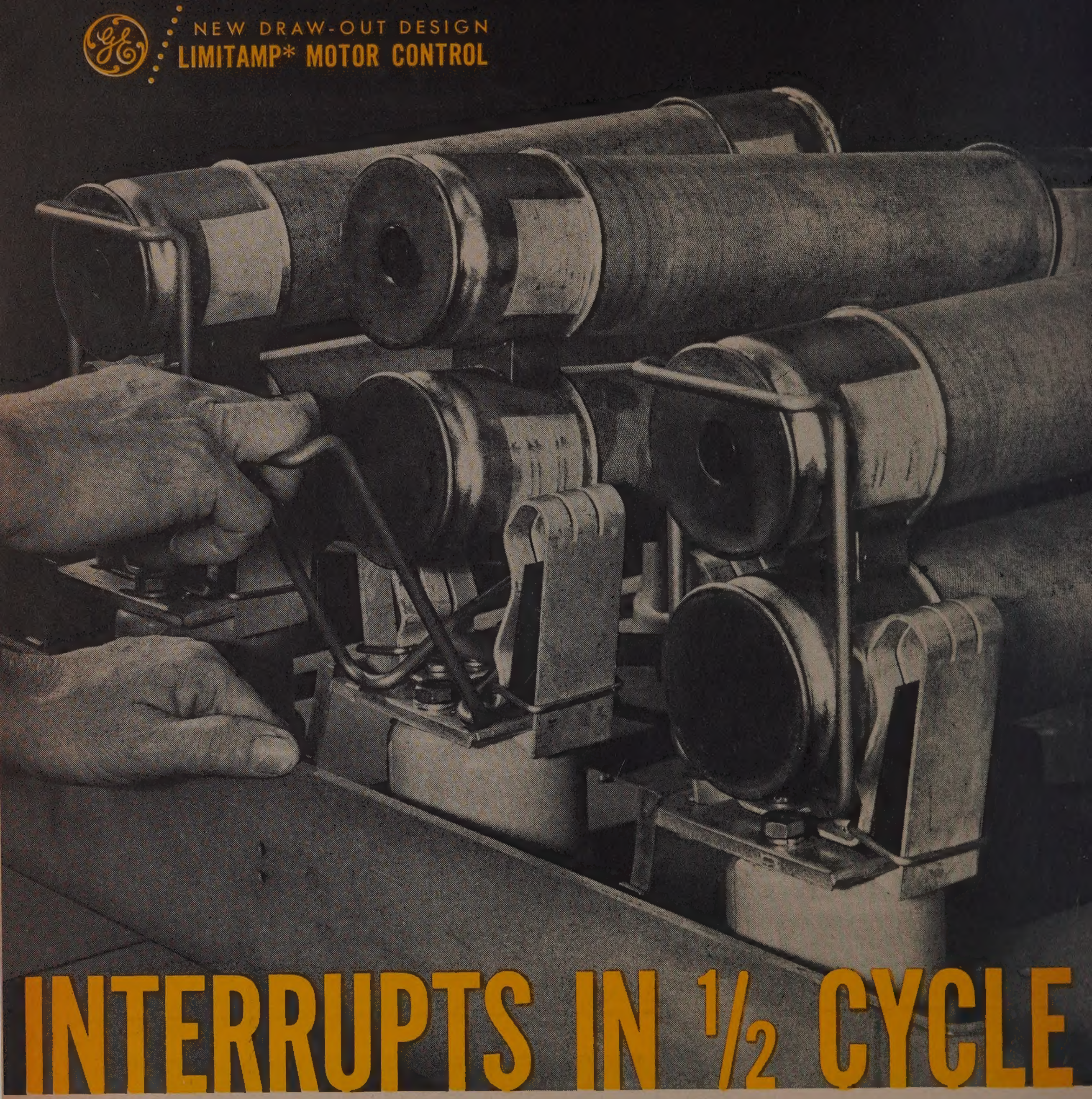
ELECTRICAL MATERIALS COST INDEX

BASE LINE (1000) REPRESENTS COSTS OF TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.



SOURCE - NATIONAL PRICE SERVICE. CLEVELAND, OHIO

NEW DRAW-OUT DESIGN
LIMITAMP* MOTOR CONTROL



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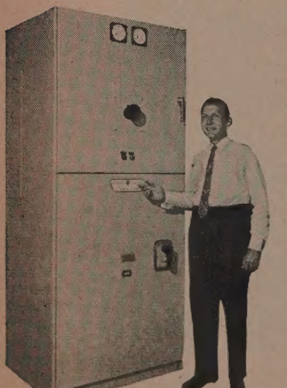

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Washington Report

NOVEMBER • 1960

Current signs point to 1961 as a good year for business, overall. Despite a decline of GNP from $505 billion in the second quarter to $503 billion in the third quarter, the U. S. economy will still wind up the year with a gross national product of about $504 billion, highest on record, and based on a sounder dollar.

The economy has already embarked on a "long period of sustainable, non-inflationary growth," according to Treasury Secretary Anderson, following a period of "fundamental readjustment" over the past year, that has resulted in a new economic environment. A group of less optimistic business economists have predicted an upturn in the economy by mid-1961, due to increased Federal spending. Also top management economic advisers for the Business Advisory Council of the Commerce Dept., recently predicted a sturdy rise in the economy beginning in the third quarter of next year.

The 1960 weakness in the economy, it is generally agreed, has been due primarily to a readjustment in inventory buying, with an overall dip in manufacturing of about 5%, and a decline in residential construction. Employment and personal income still remain at a record for this season of the year.

Homebuilding declined in September to 103,400 units, from 129,900 in August, continuing a downward trend which began twenty months ago. This was a 20% drop from August, and 29% below September 1959 starts. Federal Housing Chief Norman P. Mason attributed the drop to "pie-in-the-sky (political) promises," which may have persuaded buyers to hold off on home buying. An economic explanation is that construction of new homes since World War II has caught up with demand.

Home builders and realtors generally blame the drop in home building on the public's uneasiness over the economy, on a supply of new houses in excess of demand, and on prices of new houses that are too high, according to a recent *Wall Street Journal* survey.

New construction expenditures in September were up slightly to a seasonally-adjusted annual rate of $55.4 billion, a rise of $420 million from August, and a decline of $200 million from September 1959. This upswing reversed a three-month decline from the May high of $55.8 billion annually.

Building construction costs rose 2.1% between June 1959 and June 1960, according to Dept. of Commerce's Composite Cost Index. This compares with an annual average increase of 3.2% over the past 10 years. In comparison, consumer prices rose 1.6%, while wholesale prices for all commodities remained almost unchanged. Labor, as a principal component of construction cost, showed an average hourly earnings increase of 5.5% over the same 12-month period, and a 5.3% average annual increase over the 1949-1959 period.

Production of electricity continues to outpace year-ago levels, as output in mid-October totaled 13,736 million kwhr, up 6.8% from the similar period a year earlier.

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How to buy panelboard trouble

The circuit breaker is the heart of a panelboard. Trouble just stands and waits for the buyer who ignores the importance of the breaker. Here's how most panelboard builders guard against it. They use I-T-E circuit breakers in preference to any other make. Reason: Superior design and construction pay off in better protection. Yet I-T-E costs no more.

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And fuses remain safe and accurate through the years. They require no expensive maintenance or recalibration — they are always ready to function the instant trouble occurs.

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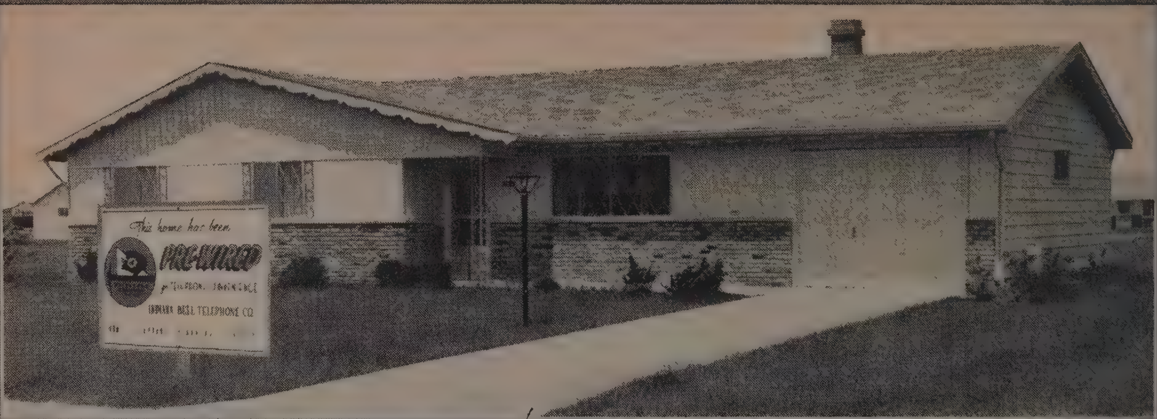


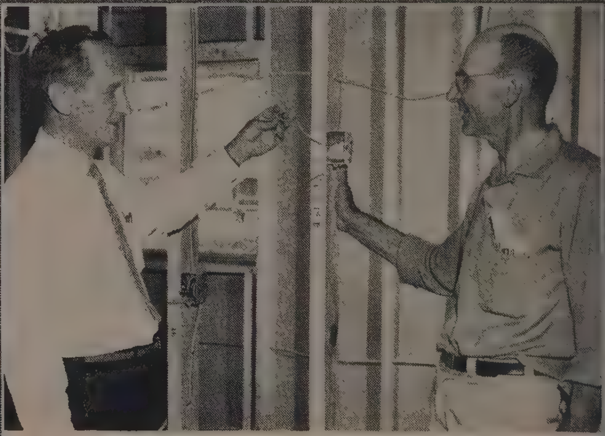
"Concealed telephone wiring is a profitable investment"

SAYS CHARLES L. BARTEL OF THE BAR-TEL COMPANY, MUNCIE, INDIANA

"The cost is insignificant compared to the convenience and satisfaction to the homeowner," says Mr. Bartel. "We've pioneered in the use of built-in telephone wiring, and we know what we're talking about. We're going to continue using it in all our homes."

Mr. Bartel, a progressive and imaginative builder, has built over 1000 homes since founding the Bar-Tel Company 22 years ago. His current project is a 133-acre tract of homes in Muncie that range from $14,500 to $40,000. Bar-Tel homes are equipped with such attractions as vaulted ceilings, eight-foot doors, movable walls, marble entrances and, of course, telephone outlets.

"Our slogan is 'You see it first in a Bar-Tel home,'" says Mr. Bartel. "The things you see in our home, you'll see everywhere else tomorrow. We've pioneered in cement slab floors, dry walls, aluminum siding and, more recently, concealed telephone wiring. Concealed wiring is the modern way to telephone-plan a home. And it certainly is a helpful sales feature."



Telephone man J. D. Douglas (left) checks telephone outlets with builder Charles Bartel.

Your local Telephone Business Office will gladly help you telephone-plan your homes. For details on home telephone installations, see Sweet's Light Construction File, 11c/Be. For commercial installations, Sweet's Architectural File, 34a/Be.

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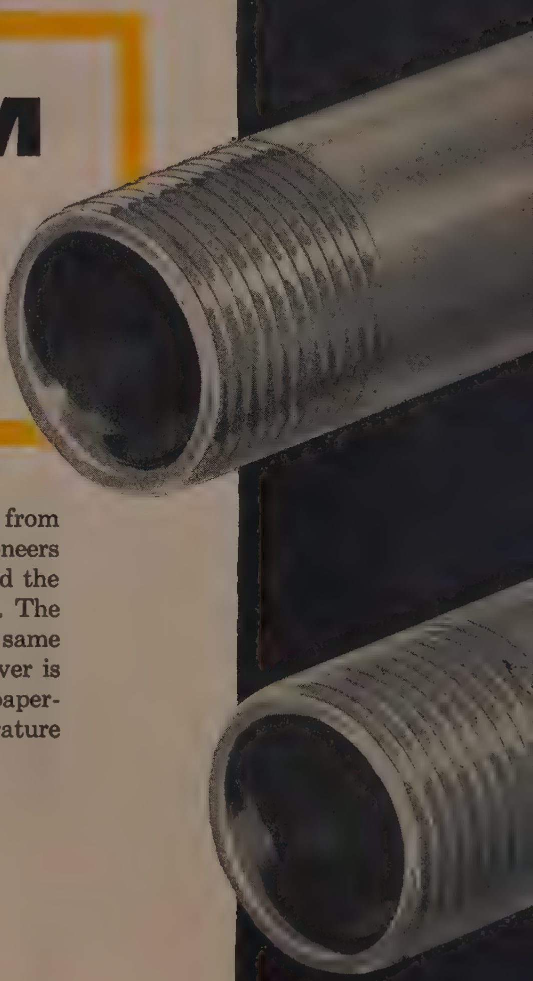
CONDUIT



Now! You can buy *both* aluminum and steel conduit from one source of supply—Clayton Mark & Company! Pioneers in conduit since 1910, we offer the best, the safest and the longest-lasting conduit made under modern facilities. The availability of Aluminum Rigid Conduit from the same experienced manufacturer allows you to offer whichever is specified for the job . . . thus saving you duplicate paperwork, effort, time and money. Write today for literature and quotations on *both* aluminum and steel conduit.

"THE CONTRACTORS FAVORITES"

HOTKOTE GALVAKOTE ENAMELKOTE
RIGID ALUMINUM CONDUIT

CLAYTON MARK
AND COMPANY
1900 DEMPSTER STREET · EVANSTON, ILLINOIS · U.S.A.

PUMPS WATER WELL SUPPLIES CONDUIT UNIONS TUBING

ALUMINUM CONDUIT

- Lightweight
- Corrosion-Resistant
- Easy to Cut and Bend
- Non-Magnetic
- U/L Approved
- Color-Coded Thread Protectors
- Meets Federal Specifications

STEEL CONDUIT

- Durable and Sturdy
- U/L Approved
- Special Interior Enamel
- Wires Pull Through Easily
- Zinc-Coated Threads
- Meets Federal Specifications

NEW GENERAL ELECTRIC SIZE 00 STARTER SAVES YOU MONEY, HAS PROVED 100-LINE BENEFITS

For small fans, blowers, pumps, compressors, other low hp applications

Designed to handle low-horsepower applications, General Electric's new 100-Line Size 00 Magnetic Starter costs you 18 percent less than the Size 0 starter in its most popular forms.

Rated at 1 hp, 230 volts single-phase, 2 hp, 550 volts three-phase maximum, the Size 00 starter can be used for remote as well as automatic operation by installing a push button or selector switch in the cover.

The new Size 00 starter also gives you the same proved-in-operation benefits—easier installation, quicker inspection, and maintenance without tools—common to all starters in General Electric's 100-Line family. For instance, it features straight-through wiring, snap-slide construction, and pressure type terminals.

For more information on this new low-cost starter and the Measurable Advantages it offers you, ask your nearby G-E Distributor for Publication GEA-7304 or write to Section 812-04, General Electric Co., Schenectady 5, N. Y.

COMPARATIVE HORSEPOWER RATINGS, SIZE 00 AND SIZE 0

Starter Size	Single-Phase			2- and 3-Phase		
	115V	230V	440/600V	110V	208/220V	440/550V
00	1/3	1	—	3/4	1 1/2	2
0	1	2	3	2	3	5

Progress Is Our Most Important Product

GENERAL ELECTRIC

WORLD'S MOST WIDELY USED ELECTRICAL TEST INSTRUMENTS

AMPROBE®

THE ONLY LINE THAT COVERS ALL YOUR TESTING NEEDS

The original pocket size
snap-around volt-ammeter-ohmmeter

AMPROBE RS-3

5 current ranges. 3 voltage ranges. Ohmmeter specially designed for the maintenance field. Rotary scale for faster reading and greater accuracy. Pointer-Lock "freezes" pointer at reading. Advanced printed circuitry laughs at rough handling. Advanced movement design—new internal core magnet with self shielding characteristics. **By itself, the Amprobe RS-3 handles 99% of your test needs. With the Amprobe Deca-Tran and Amprobe Energizer it covers EVERY testing situation.**

Only **$52.50**

AMPROBE RS-1

The economy snap-around volt ammeter with many features of the great RS-3 including rotary scale, pointer lock, printed circuit, and advanced movement design. 4 current ranges. 2 voltage ranges.

Only **$39.85**

AMPROBE JR.

The advanced voltage tester that gives you current, too. Available in seven models, ranging from 10 amps to 100 amps in either 125/250 or 150/600 volts. Choose the model that fits your job.

Only **$19.85**

AMPROBE TEST-MASTER KIT

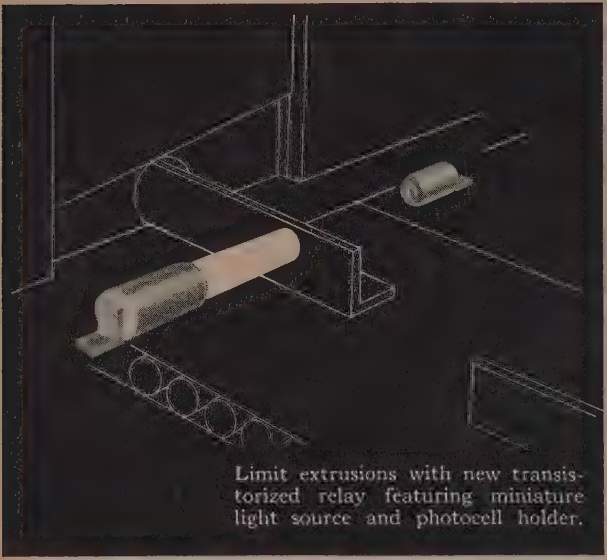
Keep all your electrical-test tools right at hand with this rugged, genuine cowhide leather carrying case. The Amprobe **Test-Master Kit** contains either the RS-3 or RS-1, the Amprobe **Deca-Tran** (extends amperage readings 10x; as high as 1200 amps), the Amprobe **Energizer** (multiplies sensitivity of any Amprobe 10x for readings on small appliances and fractional h.p. motors), and a separate covered section to hold your small hand tools within easy reach.

Model TM-33 (with the RS-3): *Only* **$84.50**
Model TM-11 (with the RS-1): *Only* **$71.75**

PYRAMID INSTRUMENT CORPORATION, LYNBROOK, N. Y. WORLD'S LARGEST MANUFACTURER OF SNAP-AROUND VOLT-AMMETERS.

FOR QUALITY . . . PRODUCTIVITY . . . PROFIT . . . MODERNIZE WITH GENERAL ELECTRIC

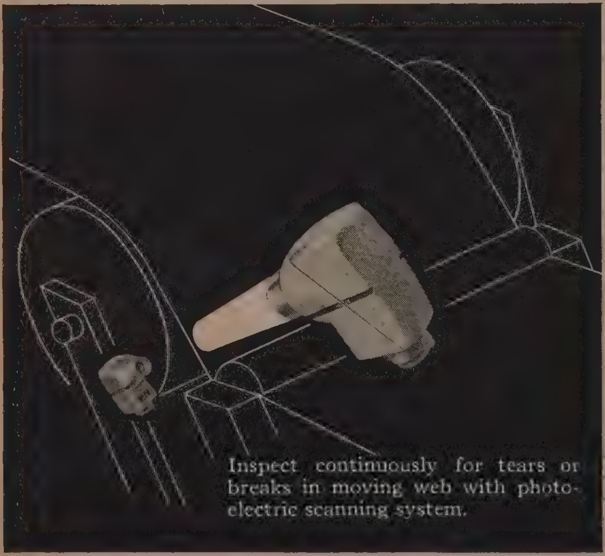
LIMITING


Limit extrusions with new transistorized relay featuring miniature light source and photocell holder.

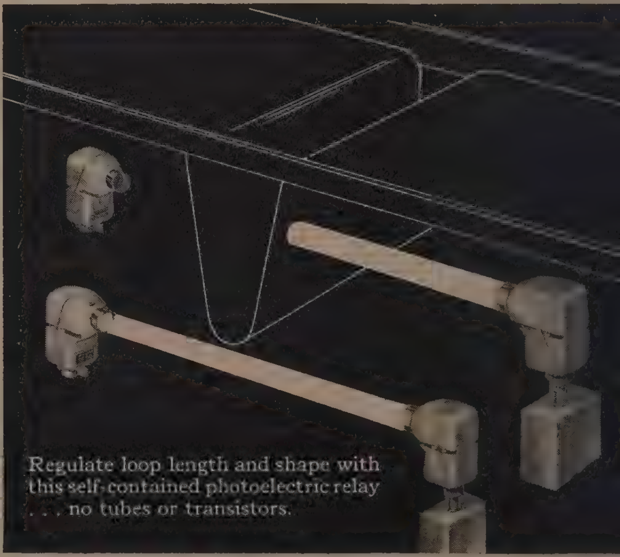
COUNTING

Record production without touching counted objects at speeds up to 600 operations per minute.

DETECTING


Inspect continuously for tears or breaks in moving web with photoelectric scanning system.

CONTROLLING


Regulate loop length and shape with this self-contained photoelectric relay . . . no tubes or transistors.

A COMPLETE LINE OF GENERAL ELECTRIC CONTROL DEVICES

Photoelectric controls
- General-purpose
- High-speed
- Long-distance

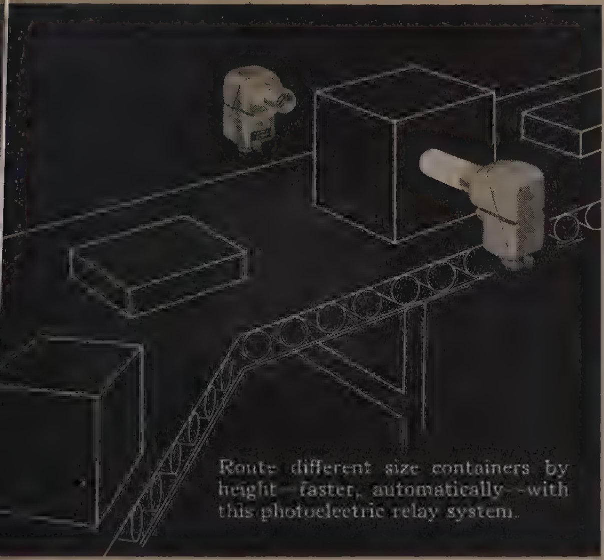
Electronic devices
- Timers
- Resistance-sensitive relays
- Voltage-sensitive relays

Photoelectric systems
- Smoke-density indicators
- Side-register controls
- Cut-off register controls

CONTROLS
FOR AUTOMATION

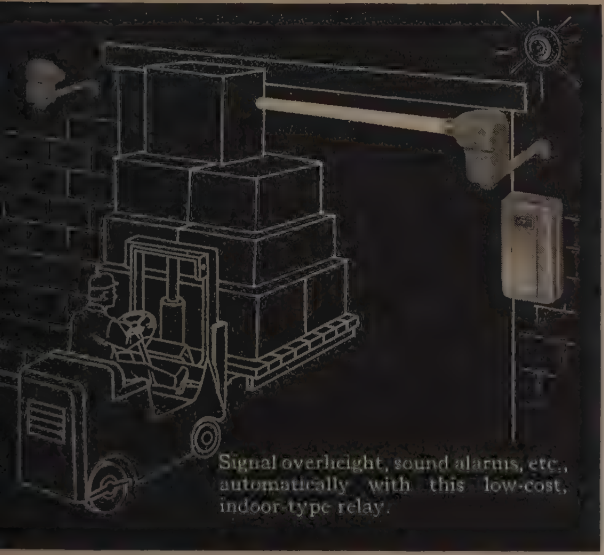
PHOTOELECTRIC CONTROLS

SORTING



Route different size containers by height—faster, automatically—with this photoelectric relay system.

SIGNALLING



Signal overheight, sound alarms, etc., automatically with this low-cost, indoor-type relay.

Switching . . . inspecting . . . counting . . . diverting . . . sorting . . . controlling. These are but a few of the *hundreds* of applications where General Electric photoelectric controls are helping our customers move closer to the benefits of automation—increased productivity, lower costs, higher quality.

Users are finding *new* ways to fit General Electric photoelectric devices into their production processes every day . . . for good reasons: These versatile G-E controls are designed for heavy-duty industrial use. They're easy to install, and require virtually no maintenance. They are highly dependable throughout a long operating life. In fact, General Electric photoelectric controls feature lamps with life expectancy of 10,000 hours—more than a year of round-the-clock operation!

ONE-YEAR WARRANTY, IMMEDIATE STOCK SHIPMENT

General Electric photoelectric and electronic devices carry a standard one-year warranty for your protection. And, your order for standard catalog devices is filled immediately from one of six regional warehouses. Also, replacement parts are warehouse-stocked, too, for your convenience and protection.

For expert help in applying General Electric photoelectric devices to your operations, call your nearby G-E Apparatus Sales Engineer or Distributor today. And, for your personal copy of our Photoelectric Devices catalog, mail the coupon below. *General Electric Co., Specialty Control Dept., Waynesboro, Va.*

SEND TODAY FOR FREE CATALOG

General Electric Co., Section H793-02
Schenectady 5, New York

Please send me a copy of the G-E Photoelectric Control catalog, GEA-6822, with description, specifications, and pricing data on the complete line.

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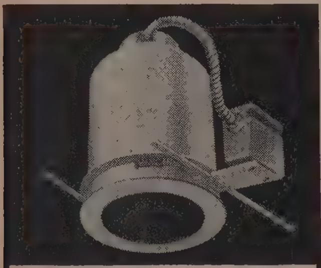
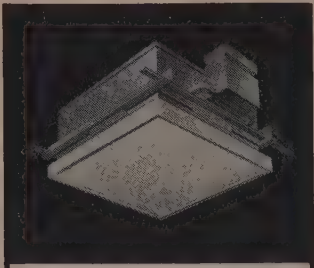
Progress Is Our Most Important Product

GENERAL ELECTRIC

Exactly the right fixture for any downlighting need. That's what Calculites offer, and that's why you'll find them written into specifications so frequently. From this broad variety of recessed incandescent fixtures, architects and engineers can select the one fixture that's styled to their liking...that gives the proper illumination for a particular location. The choice includes a total of 96 sizes and finishes, types and wattages. For instance, there's wide, medium or concentrated light distribution from 30 to 300 watts, plus a big selection of baffles, bezels and lenses. You'll find that appearance, performance and top quality construction are typically Lightolier.

DOWNLIGHTING UNLIMITED: CALCULITES





To learn more about Calculites, write today for a complete brochure to Dept. EC11

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Jersey City 5, New Jersey / Showrooms: New York, Chicago, Dallas, Los Angeles

...for a better way of Light

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* Approved by Underwriters Laboratories, Inc.
2 new Kindorf designs for fluorescent lighting support
by STEEL CITY

*** SURFACE RACEWAY SYSTEM**

Specially designed for use as a combination surface raceway and flush-mounting fluorescent fixture support. Completely enclosed from outlet box to fixture to eliminate the clutter of external conductors, this system also protects the wiring from physical damage. It's simple "slot-up" design makes it easy to install . . . easy to wire.

SIMPLEX SYSTEM

A fluorescent fixture *support* system only, its channel is applied slot-side down, and is not intended for use as a raceway. This system combines economy of investment with maximum strength and rigidity. It is easy to install and fixtures may be attached, or relocated, without lowering, or otherwise disturbing the basic channel assembly.

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made by a leading electrical manufacturer
for the electrical trade.

Write for our product bulletin g-2. "STEEL CITY lighting supports (Kindorf channel type)."

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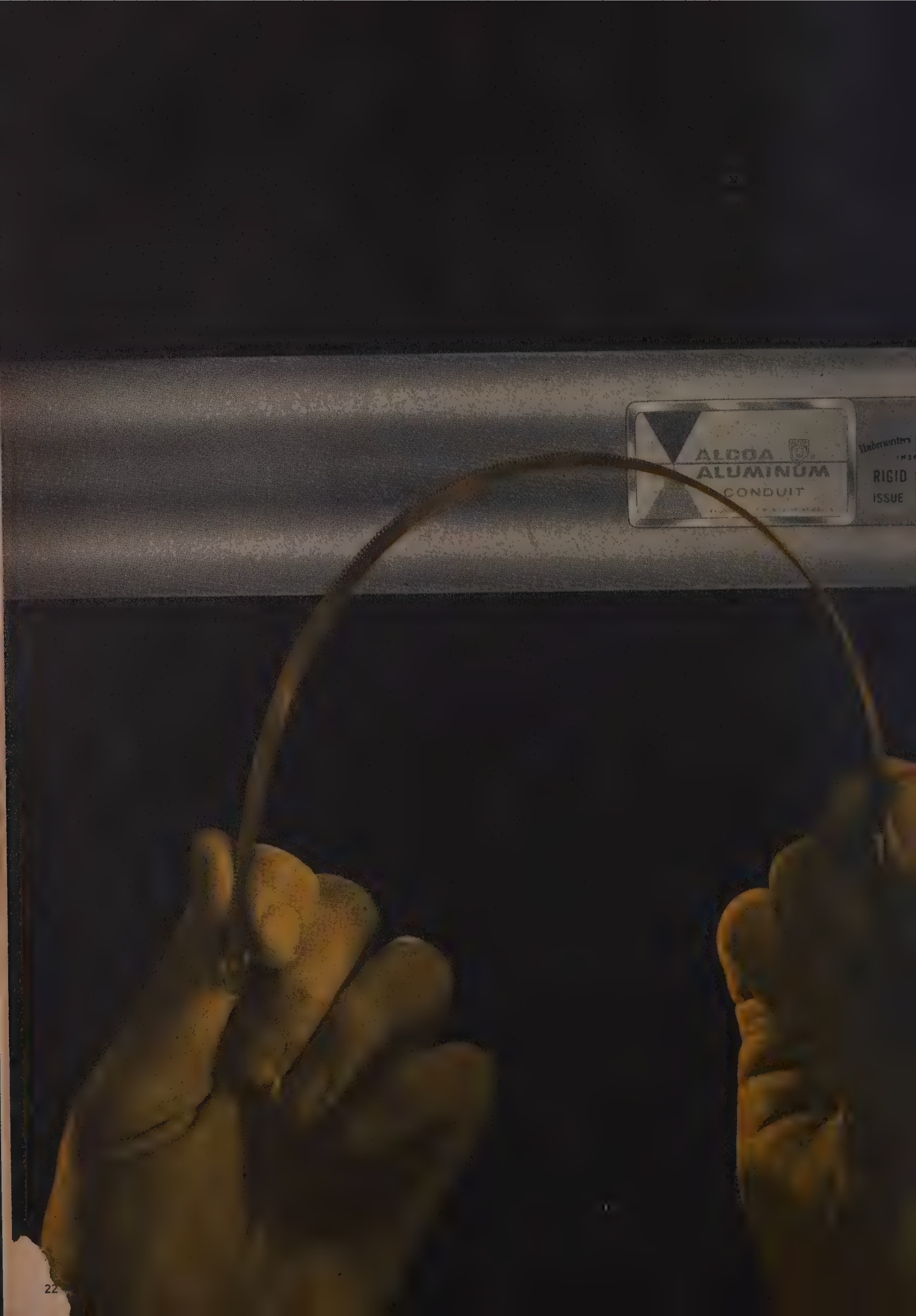
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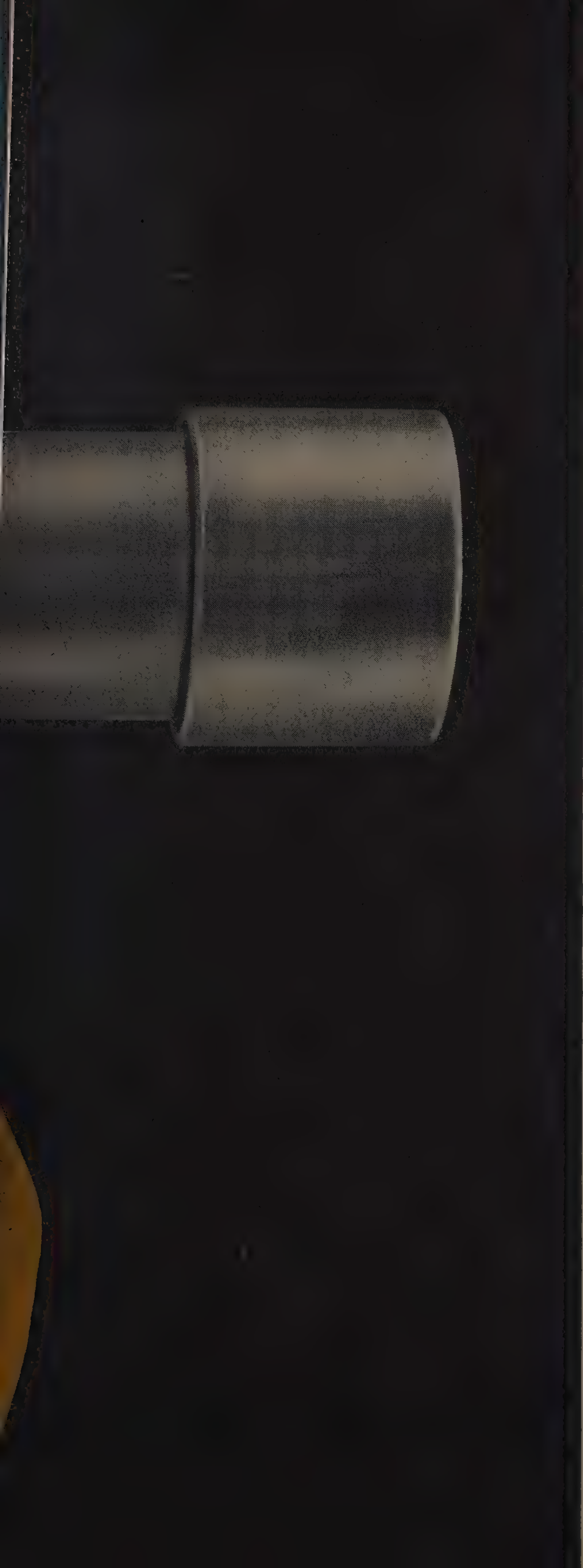
ISSUE



One hack saw blade

to install 40,000 feet of Alcoa aluminum electrical rigid conduit

That's the experience reported by a contractor (name on request) after his first use of aluminum conduit. How does this compare with the tool expenditure on your last job?

Then consider that lightweight aluminum (it's ⅓ the weight of steel) goes up *faster.* At every step—lifting, loading, carrying and erecting—handling is much easier.

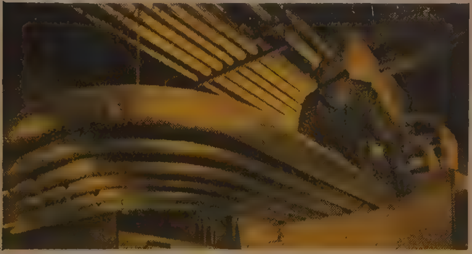
So is cutting. So is threading. So is bending. So is wirepulling.

Add it all up and you can see why more and more contractors are turning to Alcoa aluminum conduit.

From your customer's standpoint, Alcoa conduit is a sound investment, too. It's corrosion-resistant, nontoxic, nonmagnetic, long-lasting and neat in appearance. And prices are competitive.

Before you quote on your next job, get all the facts and figures. Contact your electrical distributor or one of our representatives.

If you would like free literature spelling out the many advantages of Alcoa aluminum conduit, write to Rome Cable Division of Alcoa, Dept 7-110, Rome, New York.



Save on installation costs by taking advantage of Alcoa aluminum conduit's light weight for ease of handling and erection.

ROME CABLE
DIVISION OF **ALCOA**

WANT TO SAVE SOME MONEY?

I-T-E Urelite individually enclosed large air circuit breakers. Available up to 600 v a-c, 15-4000 amp continuous, up to 150,000 amp interrupting.

SAVE INSTALLATION EXPENSE

Look at that roomy cable box. I-T-E Urelite® gives plenty of elbow room to the men who install it. Easy to pull and connect even extra-large conductors. You can bring them in from either the top or bottom. This design means fast, easy, low-cost installation.

SAVE MONEY WHEN YOUR LOAD GROWS

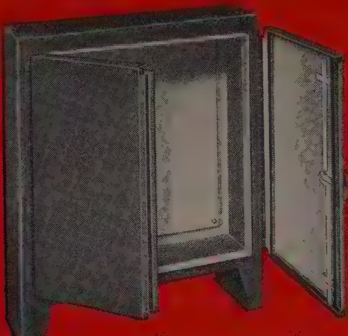
Want to increase the current rating of your Urelite breaker? Just reset the trip devices. It takes only minutes. Expanded ranges eliminate shutting down the circuit and replacing devices. Calibration is directly in amperes for easy, accurate setting.

Send for new illustrated Bulletin 4261-2b. I-T-E Circuit Breaker Company, Dept. SW., 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E | **I-T-E CIRCUIT BREAKER COMPANY**

BOSS . . . COMPLETE LINE OF ELECTRICAL ENCLOSURES

NEMA Type 12 Single Door


NEMA Type 12 Double Door

NEMA Type 1

Oil Tight Console

Oil Tight Pushbutton

BOSS

"The Line of Least Resistance"

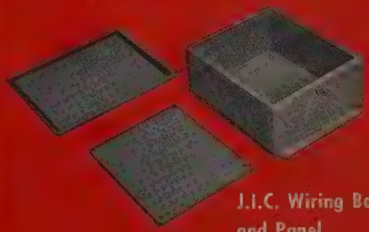
From NEMA Type 12 and J.I.C. Enclosures for critical atmospheric conditions, through all types of Wireway and Fittings . . . stock or "specials" . . . BOSS offers you *excellent quality* and *prompt delivery.*

The complete BOSS line is job-engineered for quick, easy installation. Enclosures are code gauge steel with smooth corners and firm, but easy knockouts. All are UL approved. Durable gray baked enamel finish.

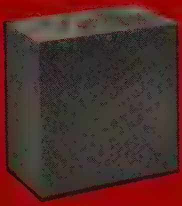
Immediate delivery on stock items from central location. Sell BOSS for increased profits. Write for Catalog on the complete line of BOSS Electrical Enclosures.

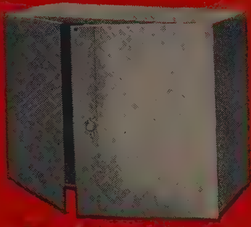
Sold thru leading distributors everywhere.

Heavy Duty Unit Enclosures


J.I.C. Wiring Box
and Panel

Type "A" Box


Screw Cover Pull Box


Transformer Cabinet

Telephone Cabinet

J.I.C. Flanged Hinge Cover

Complete Line of Fittings

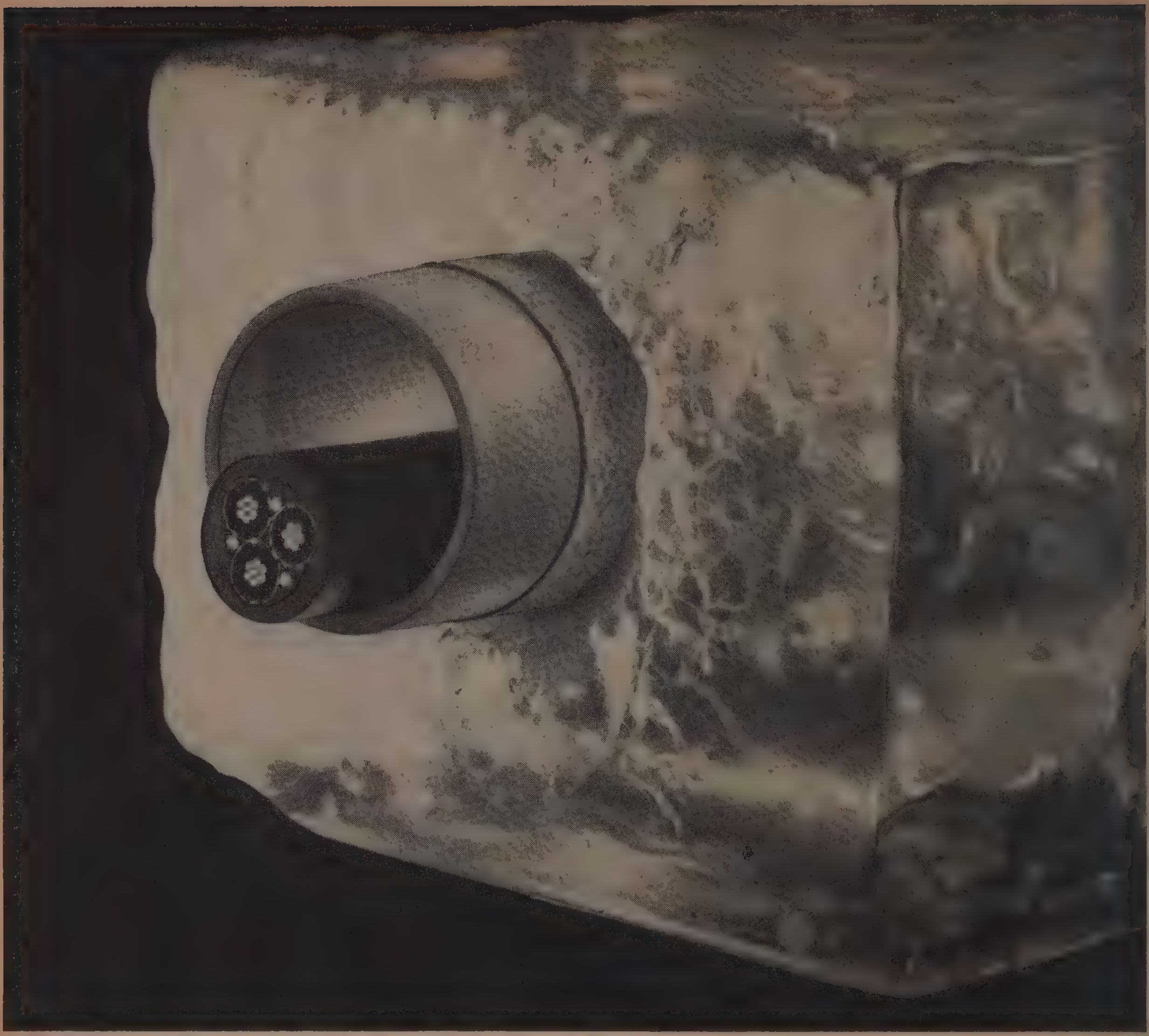
Flangeless Hinged Cover Lay-In

Flanged Hinge Cover

Flangeless Screw Cover

THE HUENEFELD CO. **ENGINEERED PRODUCTS DIVISION**

2701 SPRING GROVE AVE. CINCINNATI 25, OHIO



Cooler cables at lowest costs with Transite Ducts!

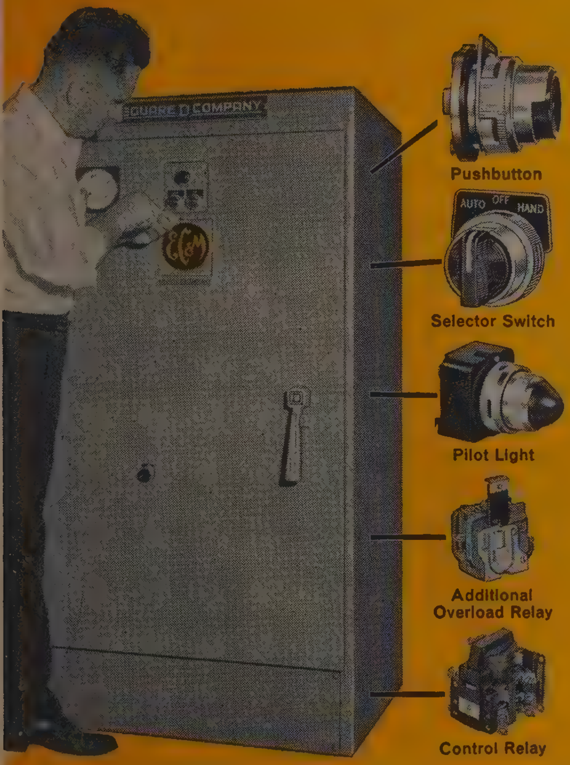
Do you know that electrical system losses amount to more than four hundred million dollars annually? Research shows that these losses can be drastically reduced by improving the dissipation of heat from conductors under load. The most efficient and economical way to accomplish this is with inorganic Transite® Ducts.

Tests prove that asbestos-cement Transite Ducts can actually have as much as 110.6% greater heat-carrying ability than organic ducts. This means that when a conductor is supplying a given load, its temperature will be substantially lower in Transite. These cooler cables result in lower electrical resistance with correspondingly lower I^2R losses. At a $20/KW cost, this can save you as much as $8.20 per thousand feet a year. Lower operating temperatures mean longer cable life and more reliable service, too!

Because of their 10′ lengths and speedy coupling method, Transite Ducts can be installed at the lowest cost. Get the full story by writing Johns-Manville, Box 14, ECM-11, New York 16, N. Y. In Canada: **Port Credit, Ontario.**

JOHNS-MANVILLE

FAST DELIVERY of SIZE 6, 7 & 8 STARTERS



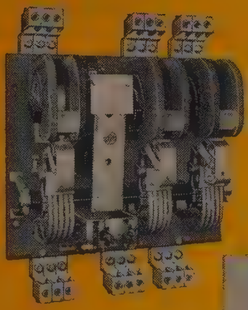
PRE-ENGINEERED MODIFICATIONS eliminate Special Engineering

Square D NEMA Size 6, 7 and 8 magnetic starters are now built with a plate in the door to accommodate modifications when needed. The same modifications which have long been available on Square D starters through Size 5—pushbuttons, selector switches, pilot lights, additional overload relays, auxiliary contacts—can now be added to the larger starters without special engineering.

This means fast processing of your order, quick delivery of your starters. What's more, you can make the same modifications in the field. The wiring diagram shipped with each starter shows exactly how to do it.

Available in ratings up to 900 hp, Square D Size 6, 7 and 8 starters can be ordered as open devices, or in general purpose, dust-tight and water-tight enclosures.

- With Square D Size 6, 7 and 8 starters, you get DC-operated (self-contained DC supply) mill-type contactors—at no extra cost. Exclusive Line-Arc construction dissipates heat, provides longer contact life. Self-lubricating bearings plus simple design make maintenance extremely easy. Another standard feature is lugs which accommodate either copper or aluminum cable.



- The magnetic starters shown at right—which range from Size 00 through Size 5—plus the Size 6, 7 and 8 starters described above, add up to a *complete* Square D line for *any* AC motor application.

SQUARE D FOR A COMPLETE LINE
...SIZE 00 THROUGH SIZE 8

Write **for Bulletin 8536. Square D Company, EC&M Division, 4500 Lee Road, Cleveland 28, Ohio**

SQUARE D COMPANY
EC&M DIVISION • CLEVELAND 28, OHIO
wherever electricity is distributed and controlled

5291

how good should power cable be

...*for dielectric strength?*

At Circle, the point is not how well specifications are met—but rather *how far they can be exceeded!* Take, for example, the well-known "double voltage test" as required by IPCEA-NEMA.

IPCEA-NEMA Performance Requirements

"6.5.3 After the sample has been immersed for at least one hour, it shall withstand for 5 minutes a test voltage which is twice the test voltage given in Table 12."

"6.5.4 . . . starting with the voltage at which the test described in 6.5.3 was made, the voltage shall be raised in steps of approximately 20 per cent of the immediately preceding voltage until failure occurs, the voltage to be kept constant at each step for 5 mintues."

"Circlesheath® Type RR Power Cable Performance"

The following table describes the performance of three samples of Circle butyl-insulated Type RR power cable.

CABLE SIZE	RATED VOLTAGE	DOUBLE AC TEST VOLTAGE	CIRCLE B'KDN VOLTAGE	MAXIMUM STRESS IN VOLTS PER MIL
2 AWG	5KV	28KV	48.3KV	454
1/0 AWG	5KV	28KV	40.3KV	356
500 MCM	5KV	31KV	44.6KV	307

A Circle power cable, subjected *for over two years* to a 250% overload of rated voltage in a *test still in process,* continues to meet all specified requirements.

Turning out high-reliability power cable requires expert knowledge of compounds, absolute quality control—and men who *know enough* to produce the very best. Next time you specify power cable, ask for Circle—there's no finer made.

Circle Wire & Cable Corp., Maspeth, N. Y.

Circle CIRCLOC* Interlocked Armored Cable combines flexibility with mechanical protection in one lightweight, economical construction. It trains easily over obstructions; is ideal for future plant expansion. Available in galvanized steel, bronze or aluminum armor—from 600 to 15,000 volts.

C W C **CIRCLE** WIRE & CABLE
a subsidiary of
Cerro de Pasco Corporation

RUBBER COVERED WIRE & CABLE • VARNISHED CAMBRIC CABLE • PLASTIC INSULATED CABLE • NEOPRENE SHEATHED CABLE • CIRTUBE* EMT

You get PEAK lighting performance

. . . when fixture ballasts wear this emblem!

CBM Ballasts [illegible] by tests regularly at E.T.L.

. . . And that's only one of the many advantages this emblem assures you!

CBM CERTIFIED by ETL

Because "CBM Certified" means fluorescent lighting ballasts engineered for dependable service. They have to be . . . to meet CBM "specs"! Result: Practical benefits for you . . . that include longer ballast life . . . up to 2500 hours more lamp life . . . power factor correction . . . and positive starting. You get savings in installation, too, since fixtures with CBM ballasts mean fewer circuits needed. And you get the assurance of perfomance checked by ETL test, plus UL listing. Ask for CBM ballasts on fixtures you sell or specify. And to keep up-to-date on ballast facts, ask us to send you "CBM NEWS".

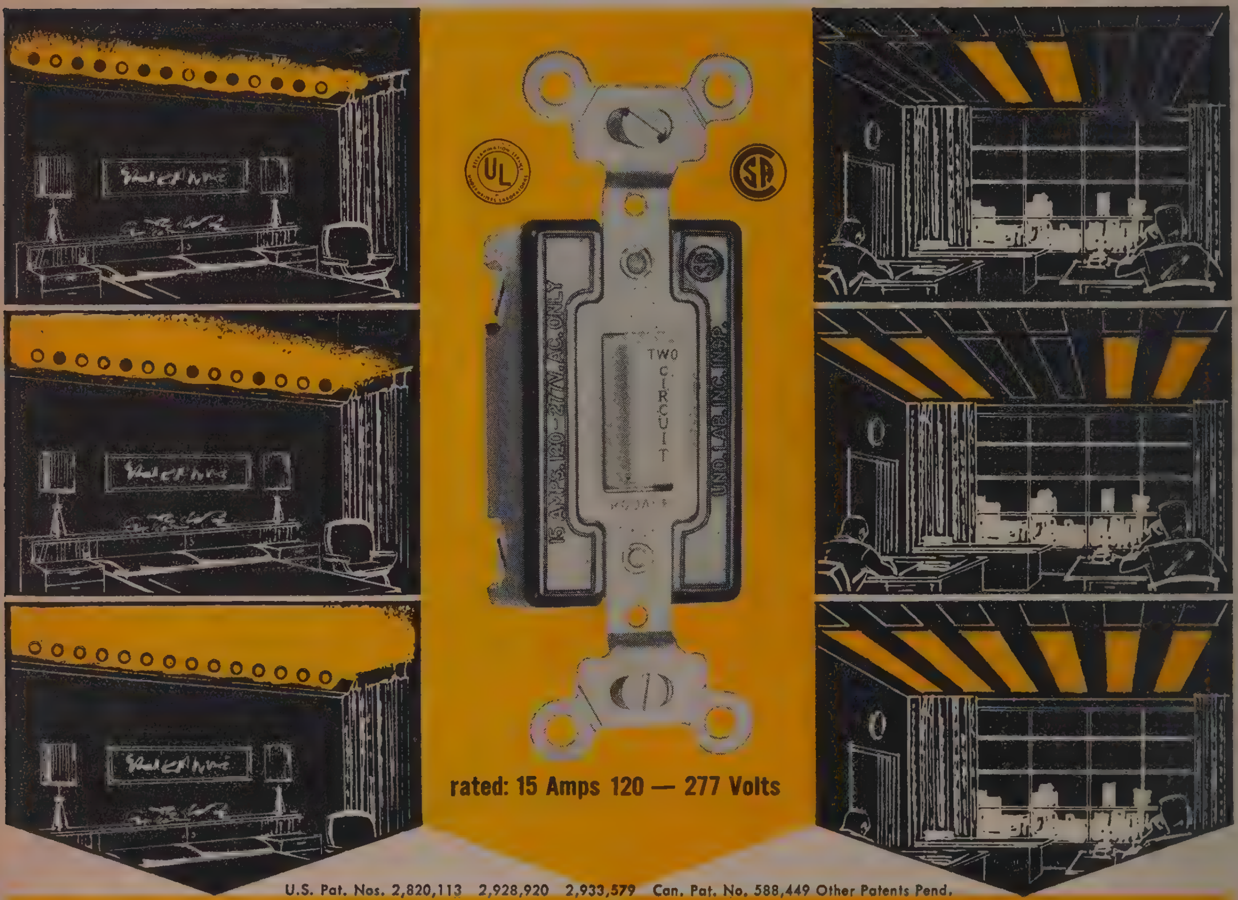
Participation in CBM is open to any manufacturer who wishes to qualify.

CERTIFIED BALLAST MANUFACTURERS, 2118 KEITH BUILDING, CLEVELAND 15, OHIO 6-60

Another **Rodale** Exclusive . . . Two Circuit *Touchette*®

DIM...MEDIUM...BRIGHT ILLUMINATION

...at the Touch of a Button



rated: 15 Amps 120 — 277 Volts

U.S. Pat. Nos. 2,820,113 2,928,920 2,933,579 Can. Pat. No. 588,449 Other Patents Pend.

WILL CONTROL THREE-LITE LAMPS FROM CONVENIENT WALL SWITCH

New Touchette ends the groping or stretching now in evidence with 3-lite fixtures. Touchette affords the welcome convenience of switching from an easy-to-see, easy-to-use standard location wall box. And, unlike rheostat-type switches, only the useable wattage is consumed. Perfect for dining room fixtures, ceiling fixtures and window displays.

Cat. No.
462

List Price
$1.60

WILL CONTROL 2 SEPARATE BANKS OF LIGHTS ON TWO SEPARATE CIRCUITS

Excellent for illuminated ceilings as well as many other commercial and industrial installations, Touchette two circuit wall switching will control alternate banks of lights . . . Switch will carry 1800 Watts at 120 Volts and 4100 Watts at 277 Volts. Convenience and economy are afforded . . . in addition to requiring just half as many switches, at least 25% of initial wiring is saved.

Sold only through electrical wholesalers.
Or for further information and prices,
write Rodale direct.

Rodale / manufacturing co., inc.
dept. ECM11, emmaus, pa.

Twice the work in half the time!

Bull Dog

PLASTIC
ELECTRICAL
TAPE

Does the work of rubber tape *and* friction tape! Saves time with swift once-only splicing . . . looks better, lasts longer because it sticks and *stays*, conforming to any shape. Low bulk makes it especially good for neat, close tolerance work. Won't creep or thin in wide range of temperatures. Costs no more. Anyway you look at it, BULL DOG VINYL PLASTIC is economy all around! BULL DOG (.007″ thickness) has minimum dialectric strength of 10,000 volts.

There's a BULL DOG TAPE for every purpose
- *Friction*
- *Rubber*
- *Plastic*

Sold only
through verified
wholesalers

AMERICAN BILTRITE RUBBER COMPANY
BOSTON WOVEN HOSE & RUBBER DIVISION
BOSTON 3, MASSACHUSETTS

BOSTON

Also manufacturers of Garden Hose, Matting, Stair Treads, Automotive Hose

CONTROL

Now! Make any pushbutton station you want with new, completely versatile Cutler-Hammer oiltight pushbuttons

Choose from a complete line of operators,
get greater circuit flexibility than with any other make

To meet today's need for a broad range of oiltight pushbuttons, Cutler-Hammer gives you a new versatile line.

You can get these rugged proved pushbuttons in one hole or base mounting, six bright colors. More than thirty different circuit arrangements are available plus hundreds of varieties of stations in standard arrangements of up to 25 elements. And you can get up to 8 circuits on one pushbutton. The flexible oil resistant diaphragm behind the button is designed to stay soft and pliable permanently.

With Cutler-Hammer pushbuttons you can get more control in less space, too, because they use 40% less behind the panel space than the next smallest unit.

Get all the facts by sending for the colorful brochure, "MASTER DESIGN" which tells you all about the Cutler-Hammer line. Ask for Pub. LO-104.

What's new at Cutler-Hammer? You can see the newness in the products coming from Cutler-Hammer, like the new smaller pushbuttons; in the new manufacturing facilities; in the new engineering ideas. All to give you better service today and in the future. Contact the nearest Cutler-Hammer sales office or your Cutler-Hammer distributor.

WHAT'S NEW? ASK...

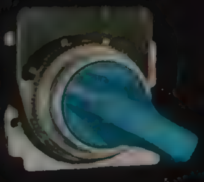
CUTLER-HAMMER

Cutler-Hammer Inc., Milwaukee, Wisconsin • Division: Airborne Instruments Laboratory • Subsidiary: Cutler-Hammer International, C. A. • Associates: Canadian Cutler-Hammer, Ltd.; Cutler-Hammer Mexicana, S. A.

CONTROL

NEW ILLUMINATED PUSHBUTTON. Newest addition to the versatile line.

YOU CAN GET ALL THESE TYPES OF CONTROL UNITS



LEVER

MUSHROOM

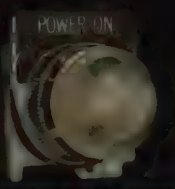
LONG

ROTO-PUSH

STANDARD

RESISTOR LIGHT

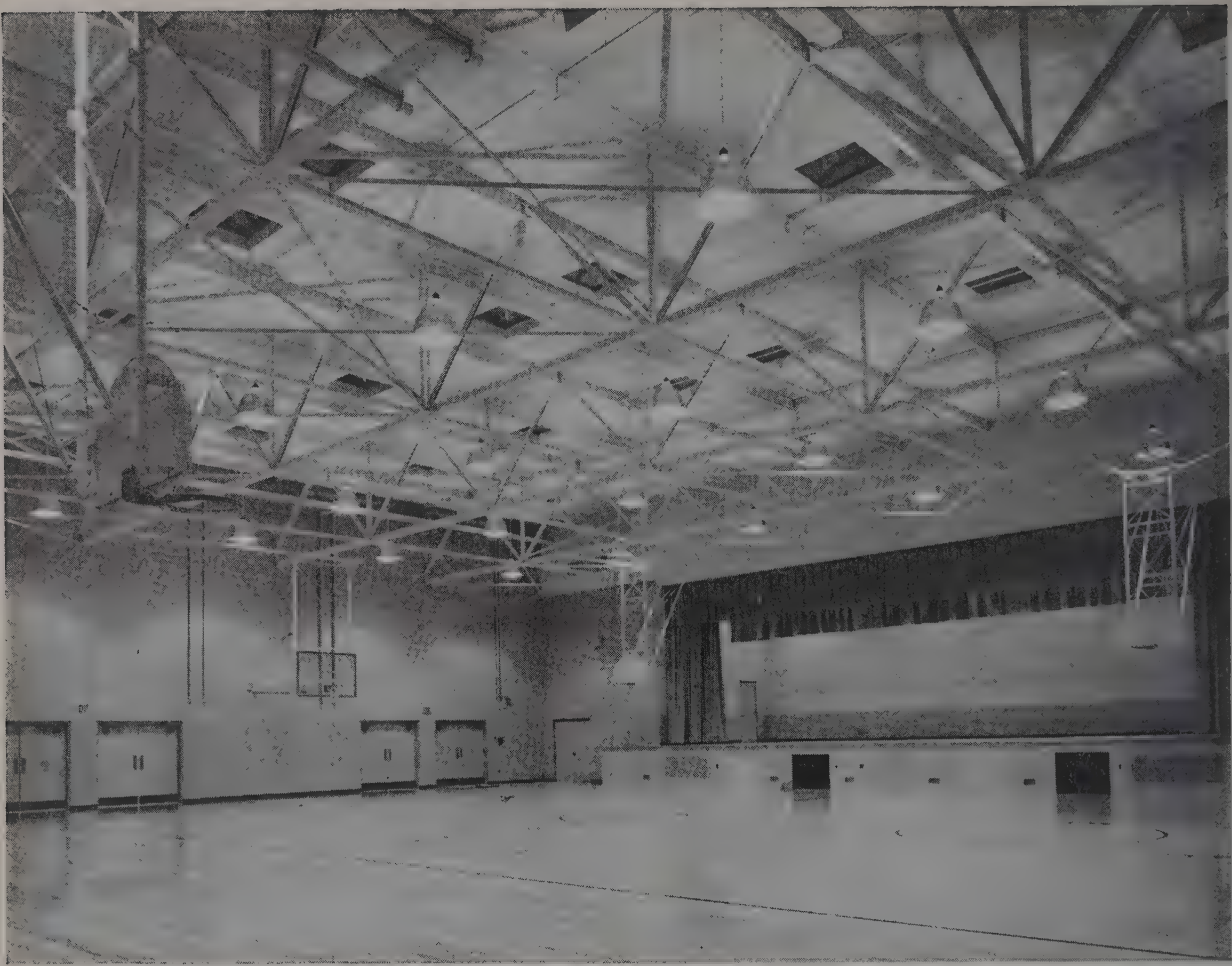
KEY



TRANSFORMER LIGHT

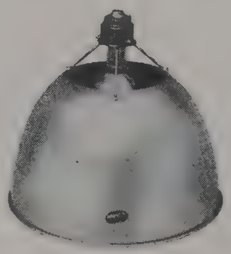
GUARDED

PRESTEST LIGHT



Wilkes Central High School, Wilkesboro, North Carolina

Not a glimmer of glare in this gym lighting job



INSTALLATION DATA

Abolite HMFAU-2400 fixtures with 750 watt incandescent lamps. Mounting height 22′ with 15′ 6″ x 16′ spacing. Ceiling height: 30′. Average footcandle level: 43.

Architect: Coffey and Olson

Consulting Engineer:
George B. Rottman & Associates

Electrical Contractor:
Ralph Duncan Electric Company

Abolite uplight fixtures shield against glare, wash out ceiling shadows—There are 43 footcandles of light (average) throughout that gymnasium, yet there's practically no glare to bother spectators or players. This easy-on-the-eyes lighting is made possible by the unique design of Abolite fixtures. Notice how both vertical and horizontal surfaces are lighted evenly without any deep shadows and how the light directed upward through the open top of fixtures eliminates sharp contrasts by washing out dark background shadows. 35° lamp shielding virtually eliminates glare.

Abolite's modern air-swept design also reduces maintenance costs. Air circulating through the fixtures sweeps them clean of dulling dust.

Although in this installation Abolite fixtures are used with incandescent lamps, they can also be used with color-improved mercury lamps. There are 18″ and 24″ diameter Alzak aluminum fixtures for use with 400 and 1000 watt mercury and 14″ and 18″ diameter fixtures for 300-500 watt incandescent lamps. *Abolite Lighting Division, The Jones Metal Products Company, West Lafayette, Ohio.*

ABOLITE
Lighting

THE JONES METAL PRODUCTS COMPANY
West Lafayette, Ohio

ALLIS-CHALMERS

Now — faster, easier hookup with new, 3-piece case design.

All-new dry-type transformers

...on the wall, wired, closed in half the time!

Now 35% smaller, lighter — new Allis-Chalmers ventilated, dry-type transformers feature exclusive 3-piece case that cuts installing time from 90 to *just 40 minutes!* New, compact size opens additional installation site possibilities previously considered too tight for conventional units.

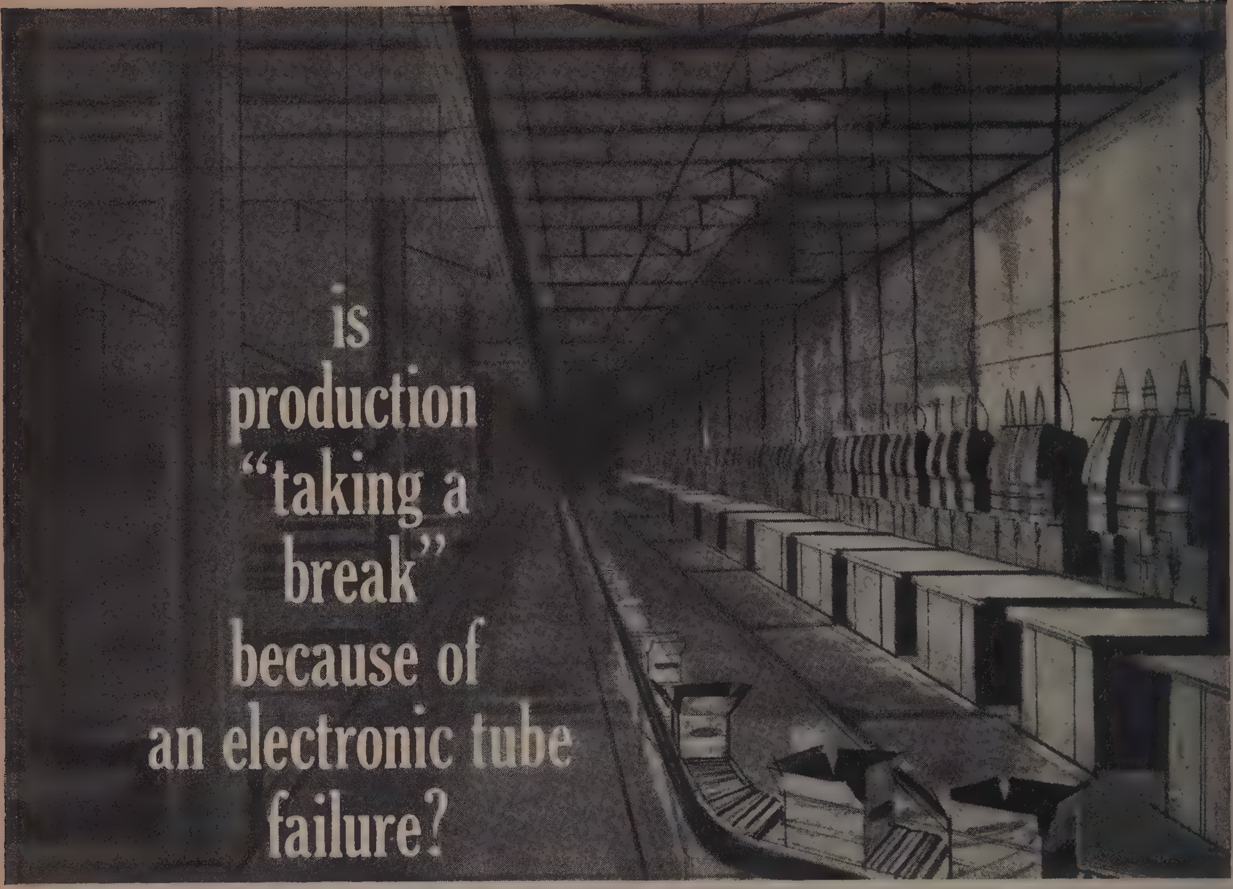
Noise level is reduced to no-hum, whisper-quiet operation by employing core impregnation . . . by isolating core-and-coil assembly from the case . . . and by use of nonresonate casing. Low core losses and low exciting current result from superior *Curvacore* construction.

This new 600-volt class indoor transformer line is available in 3- to 50-kva sizes for on-the-site load center applications where critical voltage must be maintained. And the price is right!

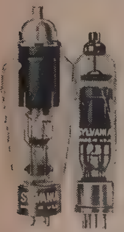
Further details are available in Bulletin 61B8222A at your nearby A-C office, or write **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin.

Curvacore is an Allis-Chalmers trademark.

A-1359



keep your line moving with Sylvania Electronic Tubes



There's a rugged Sylvania Tube for practically every industrial electronics job, including yours. Thyratrons, Ignitrons, Voltage-Regulator and Voltage-Reference Tubes—all are built to stand up under constant duty in critical industrial control applications.

Keep production efficiency high. Reduce maintenance and down time. Replace with quality-assured Sylvania Electronic Tubes—they are available promptly from your Sylvania Industrial Tube Distributor. Ask him for the descriptive "Sylvania Industrial Tubes" booklet. Or, write Electronic Tubes Division, Sylvania Electric Products Inc., Dept. 1511, 1100 Main Street, Buffalo, N. Y.

POPULAR SYLVANIA THYRATRONS

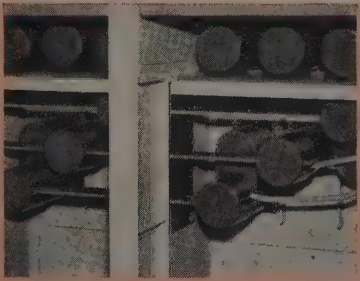
Type	Peak Inverse Anode Volts	Peak Cathode Amps	Average Cathode Amps
2D21	1300	0.5	0.1
414	2000	100.0	12.5
610	500	0.4	0.1
624	2500	80.0	6.4
627	5000	2.5	0.64
628	2500	8.0	2.0
629	350	0.2	0.04
632B	1500	30.0	2.5
672A	2500	40.0	3.2
676	2500	40.0	6.4
677	10000	15.0	4.0
678	15000	6.0	1.6
884	350	0.3	0.075
885	350	0.3	0.075
2050	1300	1.0	0.1
5557	5000	2.0	0.5
5559	1000	15.0	2.5
5560	1000	15.0	2.5
5685	1250	77.0	6.4
5796	1500	20.0	1.6
6011	1250	30.0	2.5

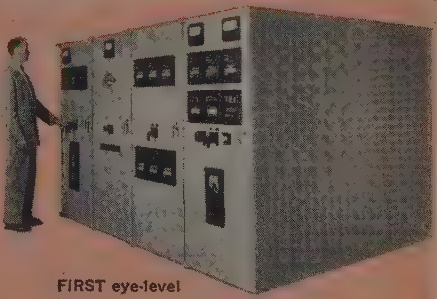
SYLVANIA

Subsidiary of ***GENERAL TELEPHONE & ELECTRONICS***

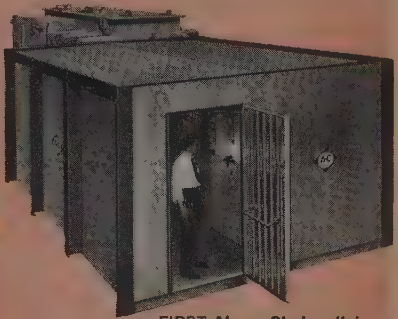
ALLIS-CHALMERS

FIRST static overcurrent relays


FIRST with track-resistant, glass polyester insulation with primary stud and bus joint


FIRST eye-level instrumentation switchgear

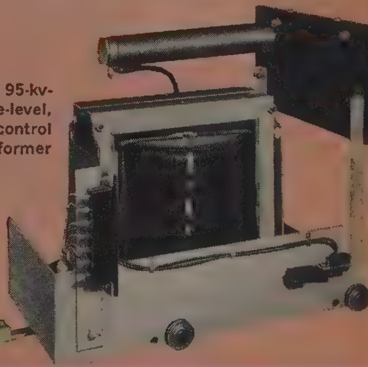
FIRST epoxy-resin potential transformers, trunnion mounted


FIRST Aluma-Clad walk-in aisle switchgear

1ST

FIRST front-access current transformers

FIRST 95-kv-impulse-level, dry-type control power transformer



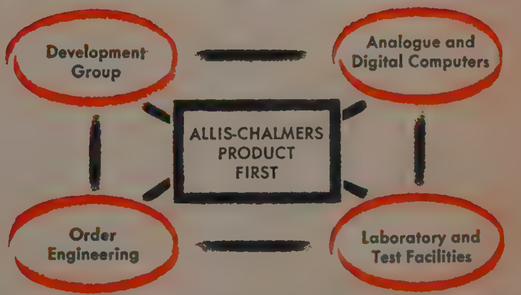
...from the company that put

Progress in Switchgear

For 113 years Allis-Chalmers has built a reputation for the finest products in the industry. A-C is continuously developing new ideas, new techniques and new products to serve you better. This same leadership spirit has quickened the pace of switchgear progress. It's responsible for the firsts illustrated above. These testify to one company's research and engineering *action*.

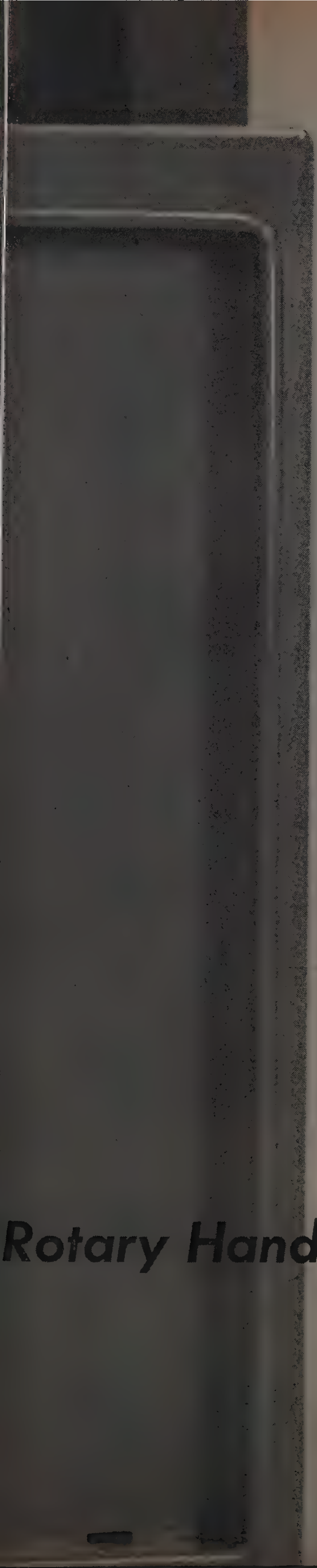
There are still better things to come in switchgear. You'll get them all when you specify better switchgear . . . designed, built and *guaranteed* by **Allis-Chalmers,** Power Equipment Division, Milwaukee 1, Wisconsin. A-1357

Aluma-Clad is an Allis-Chalmers trademark.

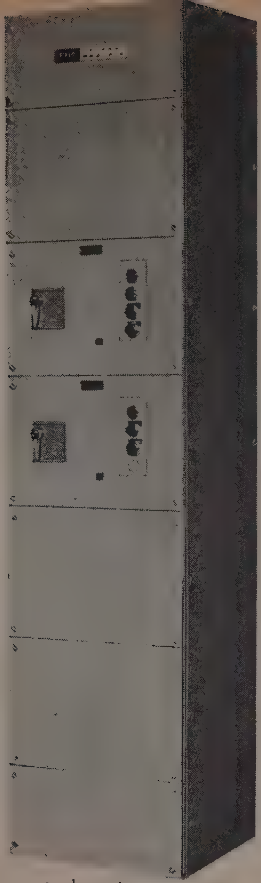

Development Group
Analogue and Digital Computers
ALLIS-CHALMERS PRODUCT FIRST
Order Engineering
Laboratory and Test Facilities

Intradepartment teamwork bridges all gaps . . . smoothly integrates information, machines and men . . . speeding overall progress in Allis-Chalmers switchgear.

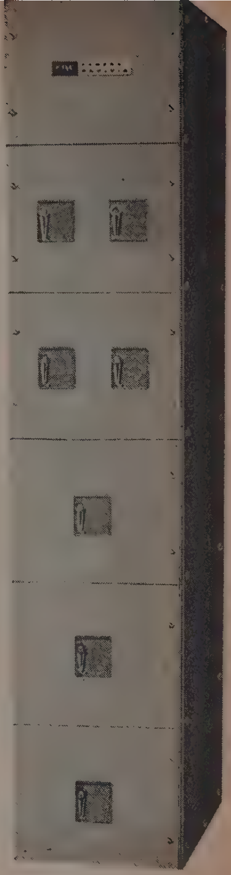
15
for safety's sake...touch nothing but
ON
TRIP
RESET
OFF



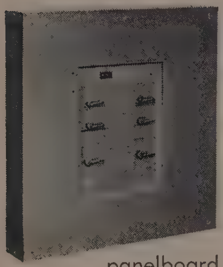
Rotary Handle!



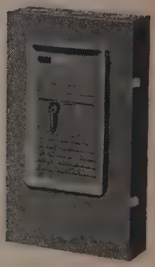
control center



switchboard



panelboard



enclosed circuit breaker

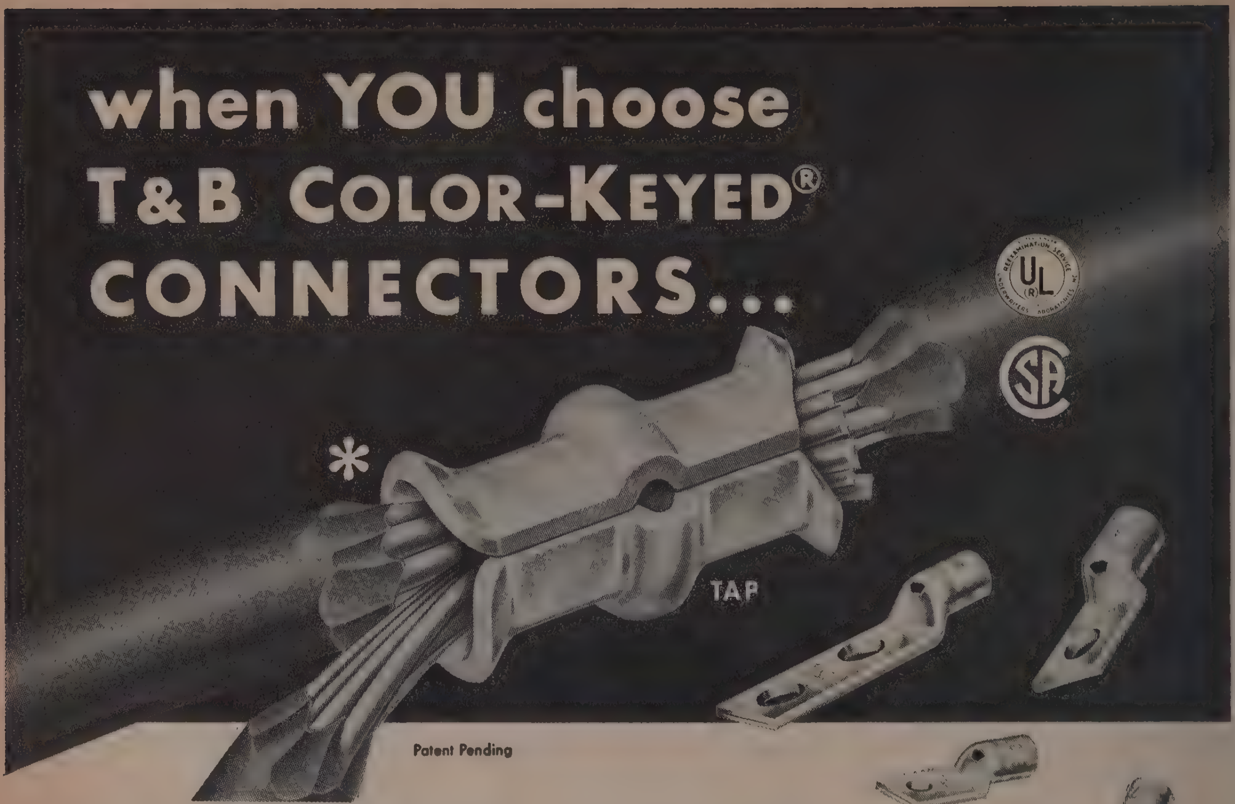
New and exclusive from Federal Pacific—Rotary Handle circuit breakers—the simplest, safest molded case breakers in the industry. Here is the one sure way to eliminate troublesome mechanical linkages . . . to forget all external mechanisms . . . to be absolutely certain of positive operation and true handle indication. Integral cylinder lock and locking ring for up to three padlocks are standard on all breakers. Federal Pacific breakers can be locked "on" or "off" independent of door position. Four frame sizes—15 to 800 amperes—meet all requirements for panelboards, switchboards, control centers and individually enclosed circuit breakers. Write for Bulletin 1425, Dept. FP-4, Federal Pacific Electric Company, Newark 1, New Jersey.

FEDERAL PACIFIC ELECTRIC COMPANY

FPE

growth through creative energy

when YOU choose T&B COLOR-KEYED® CONNECTORS...



Patent Pending

YOU CHOOSE THE ONLY COMPLETE LINE THAT COVERS THE COMPLETE RANGE FROM #8AWG TO 1,000MCM — AND THE LOWEST INSTALLED COST!

Plus...

THE NEW TBM8 HAND TOOL

The only hand tool that installs connectors from #8AWG to 500MCM.

Designed for Code Copper Conductors. There's a complete line for All-Aluminum too! The COLOR-KEYED connector line is T&B Engineered for superior performance at Lowest Installed Cost. It is the only connector system with a full range of Tooling from pocket size hand tools to 40 Ton Hydraulic heads. T&B's 65 years experience has proven that the correct tooling is as important as the correct connector.

***C-TAPS**—the newest addition to the COLOR-KEYED Line.

WRITE FOR COMPLETE LITERATURE

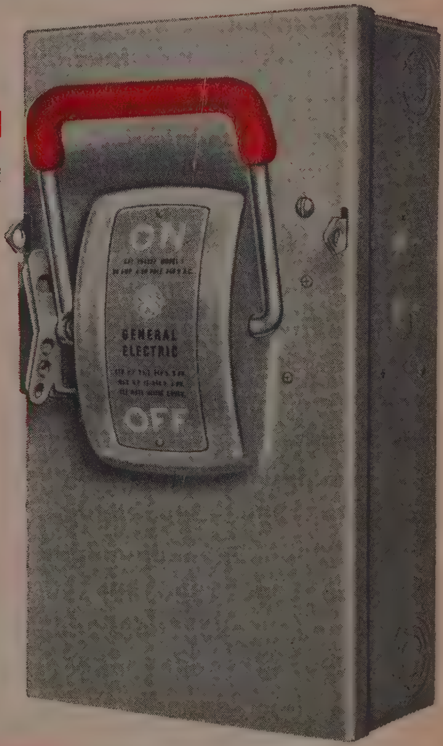
T&B ENGINEERED

SOLD COAST TO COAST EXCLUSIVELY BY YOUR LOCAL T&B DISTRIBUTOR

THE THOMAS & BETTS CO. INCORPORATED

ELIZABETH, NEW JERSEY IN CANADA, THOMAS & BETTS LTD. MONTREAL

New General Electric Heavy Duty Switches safely withstand 200,000-amp. short circuit!



All new General Electric heavy duty (TH) and heavy duty interrupter (THD) safety switches were recently tested for short circuit operation with current limiting fuses at G.E.'s High Voltage Test Laboratory in Philadelphia. The results prove that both TH and THD switches will stand up under a 200,000-ampere short circuit when used with General Electric CLF* high interrupting capacity fuses or other current limiting fuses of comparable characteristics as defined in NEMA Standards FU1-1959. An independent engineering firm supervised the tests and certified all results.

General Electric Switches are rated 30 to 600 amperes, 240 to 600 volts, and are available in both NEMA 1 and gasketed 1A enclosures. See your G-E Distributor.

*TRADE-MARK

Typical 3 Phase Tests of G-E Heavy Duty Safety Switches at 200,000 Amperes Available

Type Switch	Average Available Symmetrical Amperes	Circuit Voltage		Duration of Max. Peak Current Flow	Type of Test	
		Open	Closed		Close Device On Fault	Close Fault On Device
Heavy Duty 600 Volts a.c. Type TH	210,000	610	497	18°	X	
	210,000	610	497	36°		X
Heavy Duty Interrupter 250 Volts a.c. Type THD	203,000	256	222	18°	X	
	203,000	256	222	18°		X
Heavy Duty Interrupter 600 Volts a.c. Type THD	210,000	610	497	18°	X	
	210,000	610	497	36°		X

GENERAL ELECTRIC

Circuit Protective Devices Dept., Plainville, Conn.

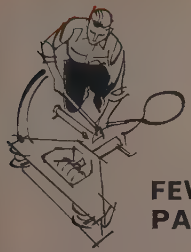
ANNOUNCING . . . the

LIGHTEST

and most powerful
4″ segment bender
on the market

Greenlee No. 777
(1-1/4″ thru 4″)
weighs only 65 lbs.
(exclusive of shoes)

COMPARE THESE IMPORTANT ADVANTAGES . . .

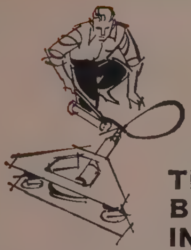


FEWER PARTS

one-piece frame of high-strength aluminum

one set of aluminum pipe supports for all pipe sizes

one set of safe, quick-locking pipe support pins.



THREE BENDERS IN ONE

a few optional parts adapt the No. 777 segment bender to fast, one-shot 90° bending 1/2″ thru 2″ and thin-wall bending 3/4″ thru 2″.

SAFE, ONE-MAN OPERATION

safety valve in pump, oil by-pass in ram, weighs only 65 lbs. excluding bending shoes.

Unmatched for over-all performance, the new Greenlee No. 777 does more jobs for you than any other bender of its type. Use it to make offsets . . . large sweeps . . . concentric bends . . . one-shot 90° bends . . . thin-wall bends.

Its 27-ton ram has power to spare for segment bending of steel or aluminum conduit and pipe 1-1/4″ thru 4″ — will bend extra heavy schedule 80 pipe. Comes equipped with a hand hydraulic pump, but can be operated with power pump for even faster performance.

OPTIONAL EQUIPMENT FOR ONE-SHOT AND THIN-WALL BENDING

One shot 90° bending 1/2″ thru 2″

90° bends in one shot An important *exclusive* advantage you get with this new, light-weight GREENLEE segment bender. Simply by adding bending shoes and adapter, you can make any bend up to 90° in 1/2″ thru 2″ conduit or pipe in *one shot!*

Thin-wall bending 3/4″ thru 2″

Quickly mounted thin-wall attachment The No. 777 segment bender can be quickly and economically converted to bend thin-wall conduit 3/4″ thru 2″. Standard No. 770 thin-wall attachments fit the No. 777 bender with only the addition of one roller.

ASK YOUR DISTRIBUTOR FOR A DEMONSTRATION NOW! Write for bulletin E-249

GREENLEE TOOL CO., 1937 Columbia Ave., Rockford, Illinois

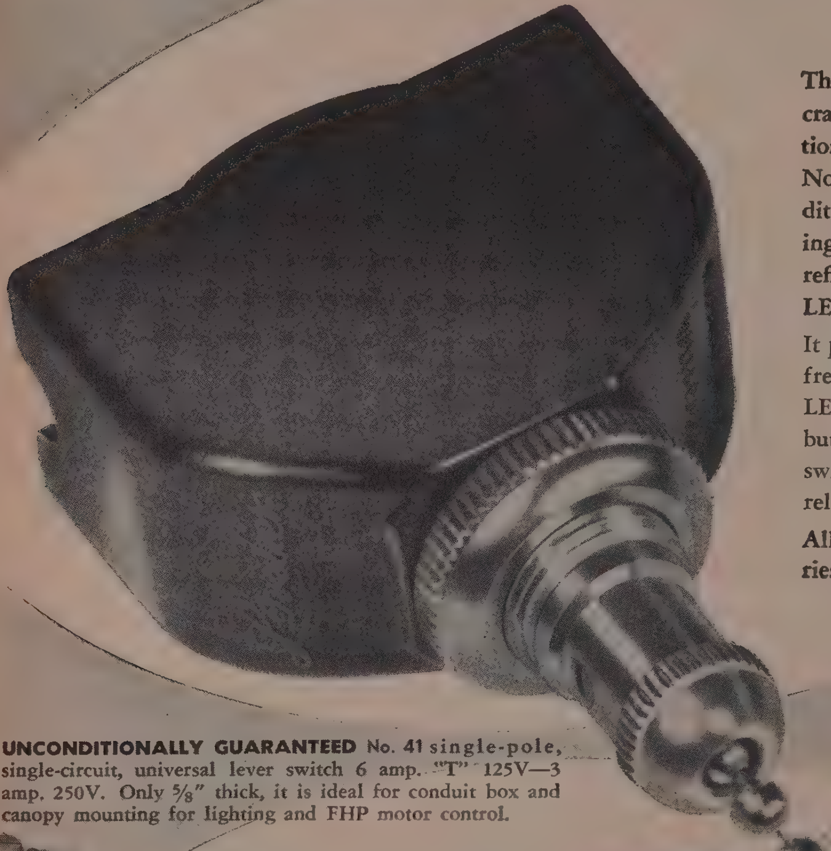
TOOLS FOR CRAFTSMEN
GREENLEE

JOB-PROFIT TOOLING

. . . cost control for contractors

Specify McGILL® *Levolier*® switches

...for guaranteed precision plus durability



The high standards of design, craftsmanship and material selection make it possible to guarantee No. 41 LEVOLIER switch unconditionally against failure in lighting circuits. This extra quality is reflected in the performance of all LEVOLIER switches.

It pays to specify the best to avoid frequent and costly replacement. LEVOLIER canopy, toggle, push button and momentary contact switches are recognized for their reliability and long life.

All are Underwriters' Laboratories inspected.

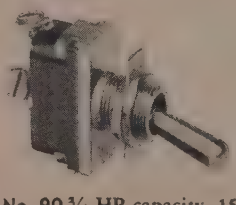
UNCONDITIONALLY GUARANTEED No. 41 single-pole, single-circuit, universal lever switch 6 amp. "T" 125V—3 amp. 250V. Only 5/8" thick, it is ideal for conduit box and canopy mounting for lighting and FHP motor control.

No. 100 single-pole, 15 amp. 125-250V, 1 HP 120-240V AC, normally "OFF" momentary contact switch. 1 amp., 125V—1/2 amp., 250V DC. Especially suitable for limit and safety control of industrial machinery.

No. 1901. Basic 30 amp. momentary contact switch rated 30 amp. 125 or 250 V AC, 1 HP 125 V —2 HP 250 V AC, 2A 125 V—1/2A 250 V DC. Available SPST NO or NC, SPDT and SPST 2 ckt. with six standard actuators. Size 1.876" x .812" x .500".

No. 71 single-pole, single circuit, universal lever switch . . . the thinnest 6 amp. "T" 125V—3 amp. 250V switch of its kind on the market today—only 15/32" thick. Also with push button.

No. 25 toggle switch carries a 6 amp. "T" 125V, 3 amp., 250V rating with an S.P.S.T. double-break mechanism. 1/3 HP AC 120-240V. Ideal for panel board, FHP motors, appliances, power tools, etc.



No. 90 3/4 HP capacity, 15 amp. 125V, 10 amp. 250V toggle switch with an S.P.S.T. mechanism. Designed for AC operation. Also carries 20 amp. 125V AC non-inductive load for heater applications. Also available in two circuit with center off and no off. Choice of terminals.

For complete descriptions of the entire McGILL line of switches, sockets, portable lampguards and other electrical specialties, write for catalog No. 84.

AVAILABLE FROM YOUR ELECTRICAL WHOLESALER

engineered electrical products

McGILL®

precision needle roller bearings

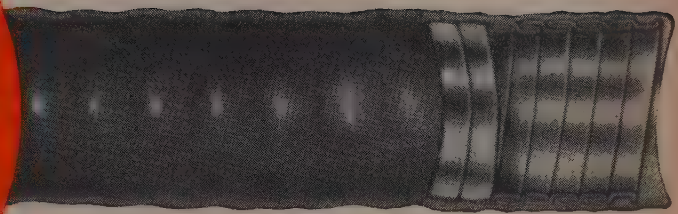
McGILL MANUFACTURING COMPANY, INC., ELECTRICAL DIV., 450 N. CAMPBELL ST., VALPARAISO, INDIANA

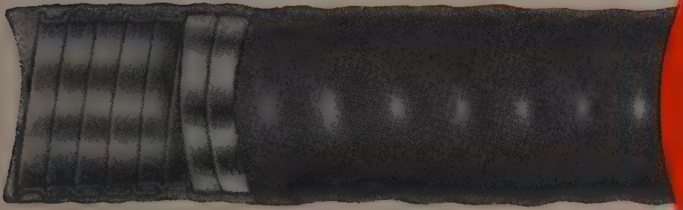
COLUMBIA

FLEX-SEAL

FLEXIBLE

liquid-tight electrical conduit





COSTS LESS*

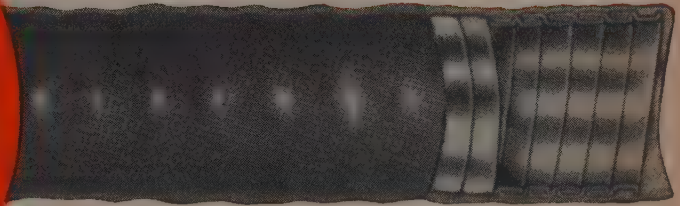
REDUCE MAINTENANCE

•

PERMANENT PROTECTION

AGAINST

WEATHER • CORROSIVE FUMES
OIL • GREASE • CHEMICALS
SALT SPRAY • DIRT
WATER

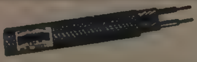


* It's a fact: your cost is lowest when your first cost is your last cost. You not only make a better installation—faster—it guarantees you a lifetime of dependable service . . . and then some.

NEC GUIDE—1960
Wallet-size guide, filled with helpful facts for daily on-the-job use. Write for your copy.

BROCHURE
Columbia Flex-Seal, type XL with bonding strip, is UL approved. Type EX, without bonding strip, is J.I.C. approved. Sizes from 3/8" to 2" ID. Write for informative brochure.

COLUMBIA CABLE & ELECTRIC CORP.
Serving the Electrical Wholesaler Since 1912
255 CHESTNUT STREET BROOKLYN 8, N. Y.

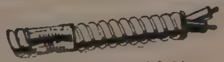


Non-Metallic Sheathed Cable

E. M. T.

Flexible Steel Conduit

Flex-Seal



A. C. T. Armored Cable

UF

What?
Splicing a
branch circuit
without tools?

YES!
because only

WING-NUT

has a built-in wrench . . .

© 1960, IDEAL INDUSTRIES, INC., Sycamore, Illinois

This one really has it! Here's the *only* one-piece screw-on wire connector with the unique wing grip. Good news for thumb-sore electricians . . . just twist Wing-Nut easily and quickly on even the toughest branch circuit wires, like stiff vinyl-insulated #6. It's so easy, no tools are needed. And in crowded boxes apply Wing-Nut, then snip off the wings.

Perfect splice? You *know* it! Your splice is always visible—no take-apart for inspection. You can actually *see* your splice is right, through the semi-transparent Nylon insulating shell. And that Nylon shell is tough, unbreakable, high-dielectric, and stable . . . won't cold-flow and short-out by stretching thin under strain or pressure.

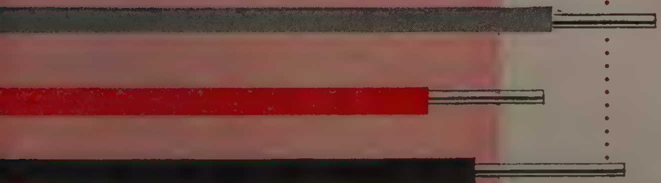
Only Wing-Nut has a Nylon shell with such a deep, wide skirt. Easily slips over two No. 8 and a No. 6, even thick Type RW. No flash-over. Two sizes of Wing-Nut handle all your needs.

***Aluminum wire, too!* U.L. has approved Wing-Nut for use as a pressure cable (600v) and fixture splicing connector for all possible combinations of standard aluminum-to-aluminum wire splices. And only Wing-Nut is also approved for 474 combinations of solid and/or stranded copper wire.**

Sound good? Then see and try the new Wing-Nut yourself.

WRITE FOR FREE SAMPLE

IDEAL



For the tools and supplies you need on every wiring job, get the finest

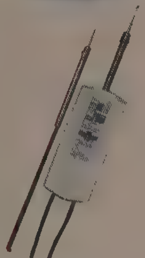
MADE BY IDEAL

NEW—FOR DIFFICULT PULLING JOBS

"FLEXI-STRAND", Ideal's new extra-flexible fish tape answers the problems of pulling wires around sharp bends. It is made of high quality preformed galvanized aircraft cable. It is more durable, and stronger, and will far out-last ordinary flat tapes. So flexible it will easily take sharp bend in any conduit without cutting. Takes extreme flexing without kinking or taking a set. Extremely high breaking point of 2,500 lbs.

"WIRE-LUBE" FOR EASIER WIRE PULLING

Easily applied by hand or brush to any rubber, or plastic-covered wire or cable, as they are being pulled into conduit. Wire-Lube protects insulation against breaks, scrapes and strains. Slides wires around bends and thru tight spots. Dries to a fine lubricating powder that makes it easy to add or remove wires later. Noncorrosive, noncombustible, absolutely harmless to hands and clothes.



SUPER-SAFE VOLTAGE TESTER

Safest, easiest-to-use voltage tester made. Designed for rugged daily use. Case is seamless plastic in Safety Yellow, with no surface metal. Prods have extra-safe no-slip grips and 30" neoprene leads. Case has center mount for one prod, with prod storage space to completely shield tips. Test for: VOLTAGE (110 to 550v AC; 110 to 600v DC) FREQUENCY (25 to 60 cycles), AC or DC. Solenoid calibrated voltage indicator functions separately from neon test lamp for super-safety. Available with special current-limiting resistors in each prod.

"E-Z" AUTOMATIC HAND STRIPPER

Strips standard branch circuit, fixture and lamp wire, and all other stranded or solid wire. Automatic stop locks jaws open after stripping until wire is removed. Eliminates crushed wire ends. Available with eccentric adjustment on blades to limit cutting depth.

"T-5" LOW COST STRIPPER

A handy addition to every electrician's tool kit. Strips No. 10, 12, 14, 16 and 18 gauge wires quickly, cleanly, easily. Cuts and loops wire. Sturdy, compact, constructed of hardened steel for rugged duty and long service. Comfortable plastic grips for sure handling and safety. Overall size, 6". Flat design fits easily into pocket or tool kit.

"SOLD THROUGH AMERICA'S LEADING DISTRIBUTORS"

In Canada: Irving Smith, Ltd., Montreal

IDEAL INDUSTRIES, Inc.,
1041-K Park Avenue, Sycamore, Illinois

IDEAL

Yes! I want the full story on the new Wing-Nut, and my free sample to try on the toughest branch circuit splice I can find. Also send me information on the full line of Ideal connectors, tools and supplies.

THE HELPING HAND ON EVERY WIRING JOB

Name____

Firm____

Address____

City____________________Zone______State____

SAMPLE

WAGNER Dry-Type *General Purpose* Transformers

...WHISPER WHILE THEY WORK

New . . . from Wagner . . . totally enclosed dry-type transformers *filled with epoxy compound.* Their designation: Type AE Single Phase, 1 to 10 Kva.

Use these transformers for all general purpose applications, including those where noise must be minimized. They have a low sound level . . . the result of encasing smaller Form W core and coils in solid epoxy compound. The compound insulates, reduces sound-producing vibration caused by core excitation . . . and provides enough support and mechanical strength to eliminate the need for metal framework and other subassemblies that are subject to vibration. *The result:* a whisper-quiet transformer that can be used anywhere, even in quiet areas of offices and hospitals.

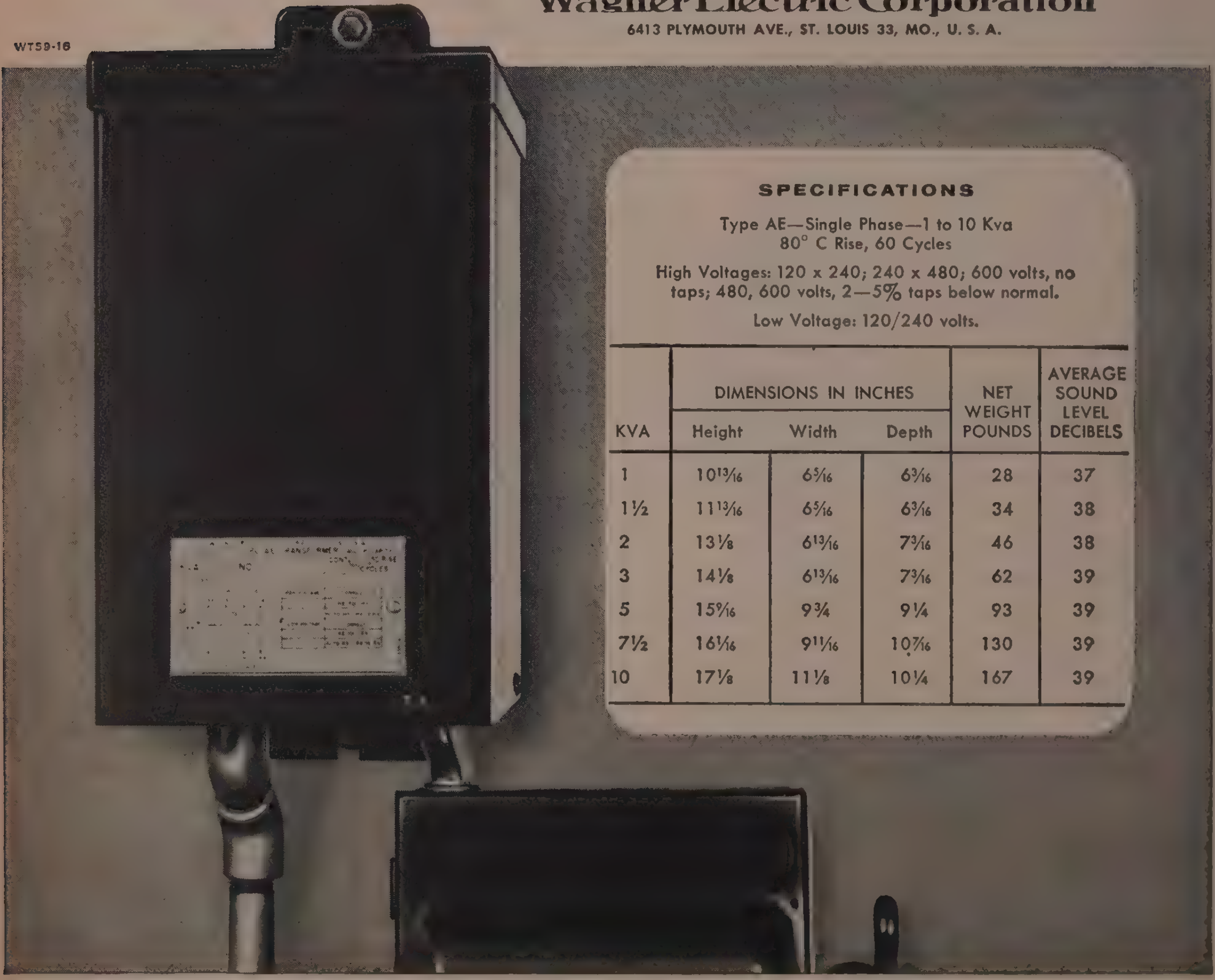
Wagner Type AE transformers do more than silence sound, of course. They improve voltage regulation, and have better insulation protection (suitable for continuous operation at 80°C in a 40°C ambient). All parts are sealed from dust, moisture and corrosion by the epoxy compound. Naturally, every unit is built to conform to all applicable standards of ASA and NEMA.

Wagner Type AE transformers can be installed indoors or out . . . in any location where they will not be submerged or exposed to injurious fumes in concentration. They are compact and lightweight and can be mounted in any position, at any angle . . . on walls, floors, or ceilings.

Like to know more? Wagner branches and distributors have all the details. There's one near you. Call or write now.

Wagner Electric Corporation
6413 PLYMOUTH AVE., ST. LOUIS 33, MO., U. S. A.

WT59-16



SPECIFICATIONS

Type AE—Single Phase—1 to 10 Kva
80° C Rise, 60 Cycles

High Voltages: 120 x 240; 240 x 480; 600 volts, no taps; 480, 600 volts, 2—5% taps below normal.

Low Voltage: 120/240 volts.

KVA	DIMENSIONS IN INCHES			NET WEIGHT POUNDS	AVERAGE SOUND LEVEL DECIBELS
	Height	Width	Depth		
1	10 13/16	6 5/16	6 3/16	28	37
1½	11 13/16	6 5/16	6 3/16	34	38
2	13⅛	6 13/16	7 3/16	46	38
3	14⅛	6 13/16	7 3/16	62	39
5	15 9/16	9¾	9¼	93	39
7½	16 1/16	9 11/16	10 7/16	130	39
10	17⅛	11⅛	10¼	167	39

CRESCENT
WIRES & CABLES

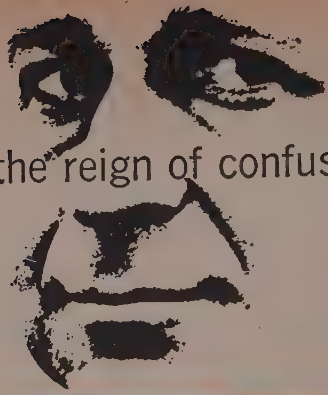
Pictured here are just a few of the many wires and cables made by CRESCENT. They have an enviable reputation for quality and endurance.

CRESCENT Quality and On Schedule Deliveries
Will Save You Money

CRESCENT
WIRE & CABLE

OVER
75
YEARS
EXPERIENCE

CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, NEW JERSEY



the reign of confusion is over

E 15-100 amps, 240 volts a-c,
125 volts d-c, 1, 2 and 3 poles
IR @ 240 volts a-c: 7500 amps

FA 15-100 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 20,000 amps
Replaces: EH, F and G breakers
Check Westinghouse for availability of this newest breaker.

JA 70-225 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 25,000 amps
Replaces: J breakers

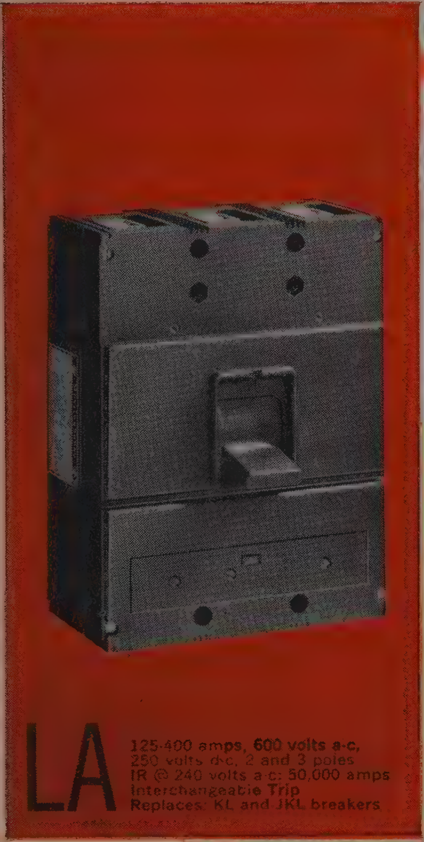
Newly Designed Westinghouse Breakers

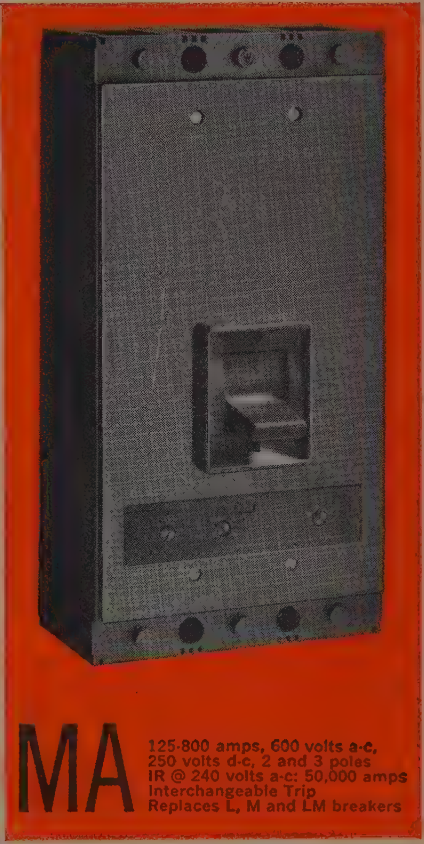
The confusing assortment of letters that tagged the breakers of the past should trouble you n
more. The reason: clear-cut designations for the new smaller size Westinghouse breaker family

New designations mean that specifying is simple . . . identifying each breaker is easy.

High interrupting ratings in smaller frame sizes mean you save as much as 50% on space.

The Westinghouse design means that you have extra-long life, unfailing reliability.


LA
125-400 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 50,000 amps
Interchangeable Trip
Replaces: KL and JKL breakers


MA
125-800 amps, 600 volts a-c,
250 volts d-c, 2 and 3 poles
IR @ 240 volts a-c: 50,000 amps
Interchangeable Trip
Replaces L, M and LM breakers

J-30320

Are Simple to Specify/Easy to Identify

Any way you look at it, the NEW Westinghouse breakers are the ones you'll want to use.

More information? Contact your nearest Westinghouse representative, Westinghouse distributor, your independent panelboard builder . . . or write Westinghouse Electric Corporation, Standard Control Division, Beaver, Pa.

For a large, plastic laminated wall chart of the new breaker line, write Westinghouse.

All Westinghouse AB breakers meet or exceed NEMA and UL specifications.

You can be sure . . . if it's Westinghouse

How to combat these electrical raceway problems

GALVANIC CORROSION *USE RIGID STEEL CONDUIT.* Its zinc coating guards it thoroughly against corrosive action when buried in concrete or soil. And it is fully compatible with all common building materials.

ELECTRICAL FIRE HAZARDS *USE RIGID STEEL CONDUIT.* Because it has good conductivity, and positive coupling, steel grounds out induced and imposed currents without danger. The strength and toughness of steel protects wiring from physical damage.

SHORT SERVICE LIFE *USE RIGID STEEL CONDUIT.* Numerous installations over 50 years old are still in service; those going in today will be serviceable even longer.

EXPENSIVE UPKEEP *USE RIGID STEEL CONDUIT.* It outlasts any number of rewirings. Its tightly bonded zinc and enamel coatings remain attractive throughout its service life.

PROTECTION OF EXPOSED RUNS *USE RIGID STEEL CONDUIT.* The strength of steel resists damage from moving objects, thus providing electrical wiring with the most thorough and dependable mechanical protection available.

REWIRING DIFFICULTIES *USE RIGID STEEL CONDUIT.* Fish tapes cannot damage its smooth, hard interior, and wiring is easy to pull in. Easy to pull out and replace, too, even many years after installation. Altering the wiring system is simple and quick where spare conduit capacity has been provided.

HANDLING DAMAGE *USE RIGID STEEL CONDUIT.* Because of its great strength, steel conduit needs no special handling, no "babying." It stays round and straight, resisting damage from all but the most severe treatment.

SLOW DELIVERY *USE RIGID STEEL CONDUIT.* Good inventories of standard types and sizes of steel conduit and fittings are always maintained by pipe mills and electrical distributors. When you specify rigid steel conduit, you're sure to be able to get it when you want it.

SPECIAL INSTALLATION EQUIPMENT *USE RIGID STEEL CONDUIT.* Electrical contractors are used to working with steel conduit, and already own—and know how to use—the necessary installation equipment. Steel conduit requires no special tools nor handling techniques. .

First in wiring protection for over 50 years, rigid steel conduit is the strongest answer to all your electrical raceway problems. Your electrical distributor will be glad to supply the details. Ask him about steel conduit soon.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Steel

For strength
. . . economy
. . . versatility

BETHLEHEM STEEL

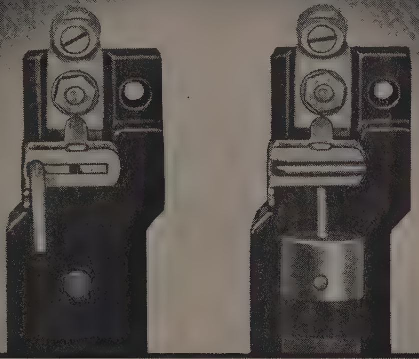
BETHLEHEM STEEL

Kamklamp Fuse Holders in

FRANK ADAM

SAFETY SWITCHES

prevent loose connections
that generate heat



Levers in Kamklamp Fuse Holders grip knife-blade terminals between vise-like case hardened steel jaws; ferrule terminals under tightly drawn steel bands. Eliminated are connections that loosen and burn.

TYPE SCSD
Standard Duty
30 to 200 amps;
240-v.—600-v. AC

TYPE SAHD
Heavy Duty
30 to 1200 amps.,
240-v.—600-v. AC

Kamklamp Fuse Holders—*exclusive* in Frank Adam Switches—lock cartridge fuse terminal immovably in position, and provide tight, flexible connections under constant tension that will not become loose and heat up. Overloads cause heat and expansion, then subsequent cooling and contraction, which loosens ordinary contacts making them flash and burn. Kamklamp Fuse Holders help eliminate this major cause of trouble.

Another Frank Adam exclusive is the rugged Shutlbrak® switch mechanism that won't arc or pit. Pre-shipment testing under loads twice the rated voltage plus 1000 volts—front handle operation that permits space-saving side-by-side installation—one piece molded pole units—these are only a few of the features that make Frank Adam Safety Switches the industry's best buy. *Write for catalog.*

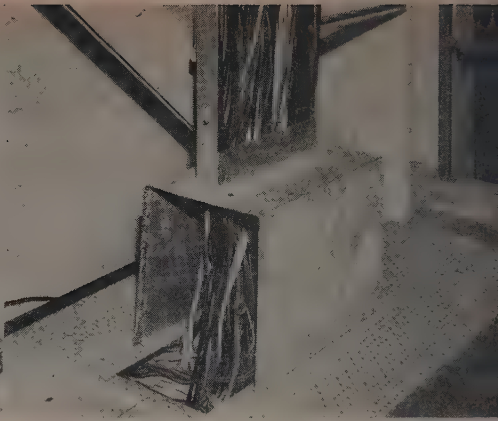
KEEP PACE ELECTRICALLY

See our catalog in SWEETS

PRODUCERS COUNCIL

FRANK ADAM ELECTRIC COMPANY SINCE 1891
P. O. BOX 357, MAIN P. O. • ST. LOUIS 66, MO.

busduct • panelboards • switchboards • service equipment
safety switches • load centers • Quikheter

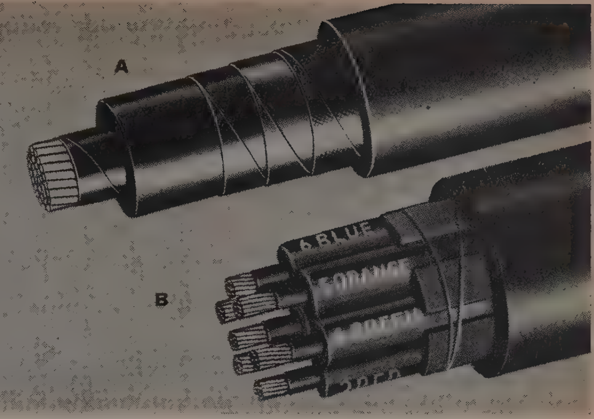


Orlando, Florida, Meets the Challenge of An Expanding Population wit

POWERIGHT
PARANITE®
POWER CABLE

A. Paranite **HIGH VOLTAGE CABLES** are manufactured in a complete range of sizes—1000 through 28,000 volt single conductor, 3000 and 5000 volt three conductor. Adaptable for aerial, direct burial or underground duct installation, wet or dry location.

B. Paranite **CONTROL CABLES** are produced in a complete range of insulation and jacket types. Rubber, PVC or Polyethylene insulations are available to meet a variety of service temperature conditions.



The ORLANDO, FLORIDA, UTILITIES COMMISSION chose Paranite for its new generating plant at Indian River. From transmission line . . . to power cable . . . through control cable Paranite was specified to carry the load in serving this dynamic and growing area.

It's another case history of the nation wide acceptance of Paranite products and demonstrates once again Paranite's 70-year reputation for quality wire and dependable service. Yes . . . men responsible for power distribution know "IF IT'S PARANITE IT'S RIGHT."®

Since 1890

PARANITE WIRE & CABLE DIVISION

ESSEX WIRE CORPORATION, Marion, Indiana

MANUFACTURING PLANTS: Marion, Ind.; Jonesboro, Ind.; Tiffin, Ohio; Anaheim, Calif.

Sales Offices and Redistribution Warehouses in all Principal Cities

CUT INITIAL COST AS MUCH AS 40¢ PER SQ FT

It's easy with the most powerful fluorescent on the market! If you're planning a new building . . . or remodeling an existing one . . . you can shave your customer's initial lighting investment by as much as 40¢ a square foot!

How? Specify G-E Power Groove* Lamps. They give more light than any other lamp. You use fewer lamps, fewer fixtures, fewer everything else it takes to light your customer's building properly. And his savings keep mounting. With fewer lamps, fixtures and ballasts, his maintenance bills will be lower, too.

The secret's in the grooves. They're what bend the arc stream (it's straight in other fluorescents) . . . lengthen it . . . make the lamp put out more light. Only G-E Power Groove Lamps have 'em. Only General Electric gives you this years-ahead light source—another example of a difference that makes a difference in value to you. Call your G-E Lamp distributor for more information. General Electric Company, Large Lamp Dept. C-031, Nela Park, Cleveland 12, O.

*General Electric's trademark for configurated fluorescent lamps

Progress Is Our Most Important Product

GENERAL ELECTRIC

Pays for itself fast . . . in labor savings alone!

RIDGID 535 PIPE & BOLT THREADING MACHINE

A Complete Pipe and Conduit Workshop At Your Finger Tips . . . For High-Speed Threading, Cutting, Reaming

Full 2″ capacity. Plenty of power for up to 12″ geared tools. Universal Die Head included threads ½″ to 2″ pipe and conduit with just two sets of dies. Four other styles of heads available . . . ⅛″ to 2″ pipe or conduit, ¼″ to 2″ bolts. Fast hand-action RIDGID Speed Chuck. Cam-Action Rear-Centering Workholder. Automatic re-circulating oil system. Easy-to-Read Length Gauge.

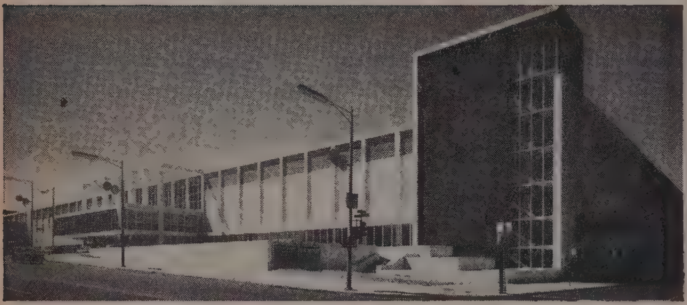
See and Try This Time and Cost-Saving RIDGID 535 at Your Supply House Today

RIDGID

THE RIDGE TOOL COMPANY, ELYRIA, OHIO, U. S. A.

In Detroit's New Cobo Hall

10 ACRES OF DRAMATIC AND FLEXIBLE LIGHTING..

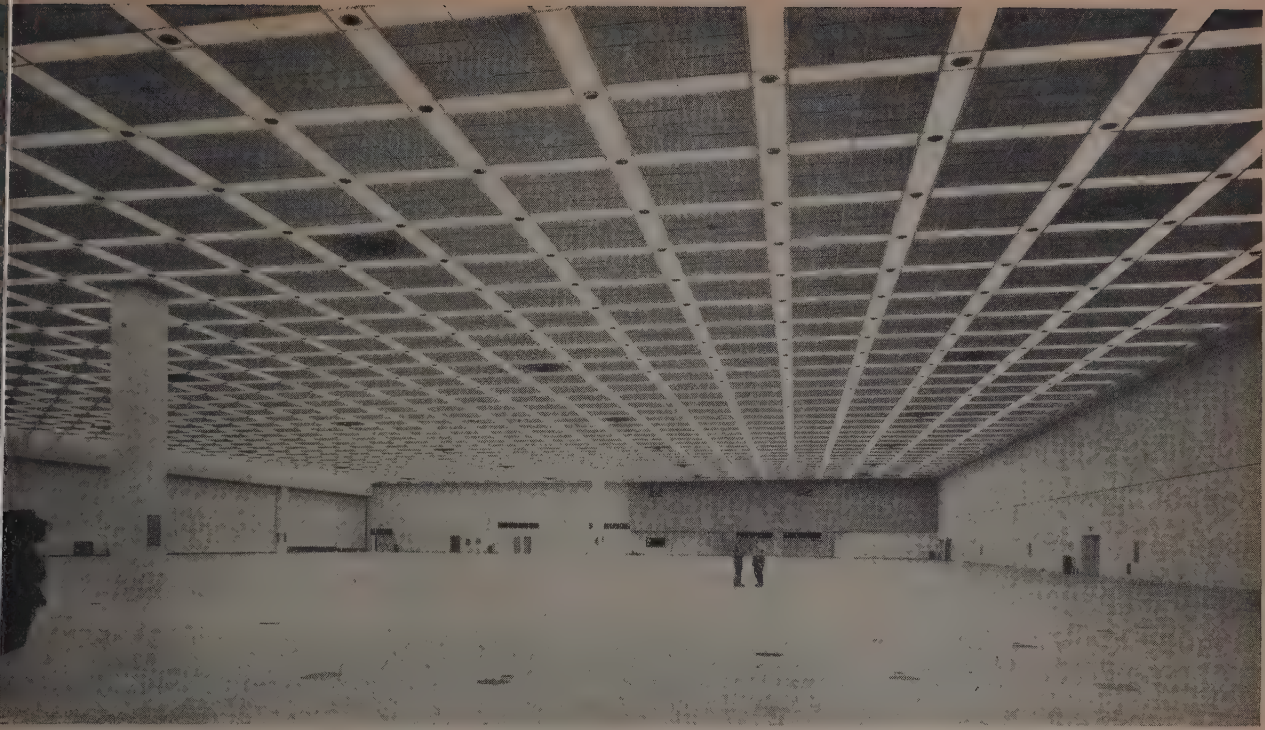


The handsome front entrance of Cobo Hall, Detroit's exciting new Convention-Exhibition Hall.

Space limits a complete description of the Sylvania lighting installation at Cobo Hall. If you are interested in a full detailed report, it will gladly be sent on request. Simply write to Sylvania Electric Products Inc., Wheeling, West Virginia.

Giffels & Rossetti, Inc., Architects and Engineers
Hatzel & Buehler, Inc., Electrical Contractor
Tarnow Electric Supply Company, Electrical Distributor

Sylvania's louvered ceiling provides 135 footcandles of general lighting for over 100,000 square feet of display area. Complete system consists of outrigger-type fixtures with eight 75-watt Instant Start lamps installed in a grid arrangement.



One of three 100,000 sq. ft. exhibit halls lighted with Sylvania's 2′ x 8′ and 2′ x 2′ Troffers in a modular pattern.

..by SYLVANIA

Cobo Hall, Detroit's new exhibition center, features one of the largest and most flexible lighting installations ever made.

On both floors of this vast exhibition hall Sylvania provides the versatile lighting needed for a wide variety of exhibition uses.

The three halls on the second floor, designed for the display of large equipment, each measure 240 feet wide by 405 feet long with a ceiling height of 30 feet. Each hall utilizes Sylvania's 2′ x 8′ lay-in Troffers and 2′ x 2′ recessed units in an attractive and eye-catching 10′ x 10′ modular pattern.

Through circuiting, six different general lighting levels up to 135 footcandles can be obtained. Keeping with the flexibility theme, each 2′ x 2′ unit contains fluorescent lamps for general lighting and one 500 watt incandescent swivel-type spot for highlighting exhibits.

On the first floor where smaller equipment will be displayed an entirely different lighting system is used. Sylvania's luminous louvered ceiling provides 2-level lighting control—either 70 or 135 footcandles—for over 100,000 square feet of display area. Again incandescent spots are installed on 14′ square modules to highlight displays.

This tremendous lighting installation illustrates Sylvania's ability to work hand in hand with architect, engineer and contractor on jobs of any size . . . from 10 square feet to 10 acres.

For your next lighting installation—check Sylvania first.

SYLVANIA LIGHTING PRODUCTS
A Division of SYLVANIA ELECTRIC PRODUCTS INC.
One 48th Street, Wheeling, W. Va.

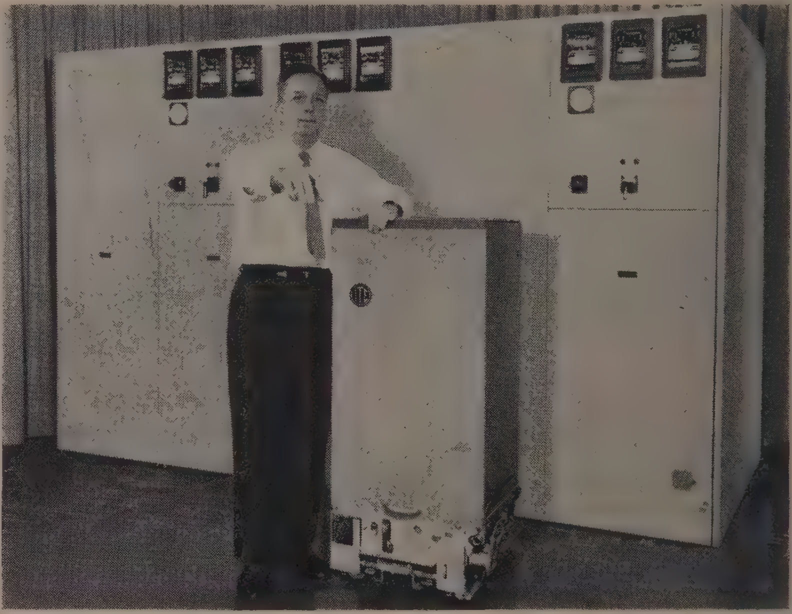
SYLVANIA

Subsidiary of ***GENERAL TELEPHONE & ELECTRONICS***

(Advertisement)

"......we knew you would want all these switchgear advances. And we were determined to bring them to you at the lowest possible cost."

—Frederick G. Schmidt, Manager Switchgear Division, I-T-E Circuit Breaker Company



Frankly, we had a big decision to make when we were designing this new HK metal-clad switchgear. Should we go ahead with a complete redesign or should we simply add the new features, we knew you wanted to our previous models? The latter would have been easier, and it still would have put us well ahead of the field. But we decided it would be more honest to give you the benefit of as much progress as possible as soon as we could. And we were confident that in this case we could give you all these advances at a price no higher than you would pay for equipment with none of them.

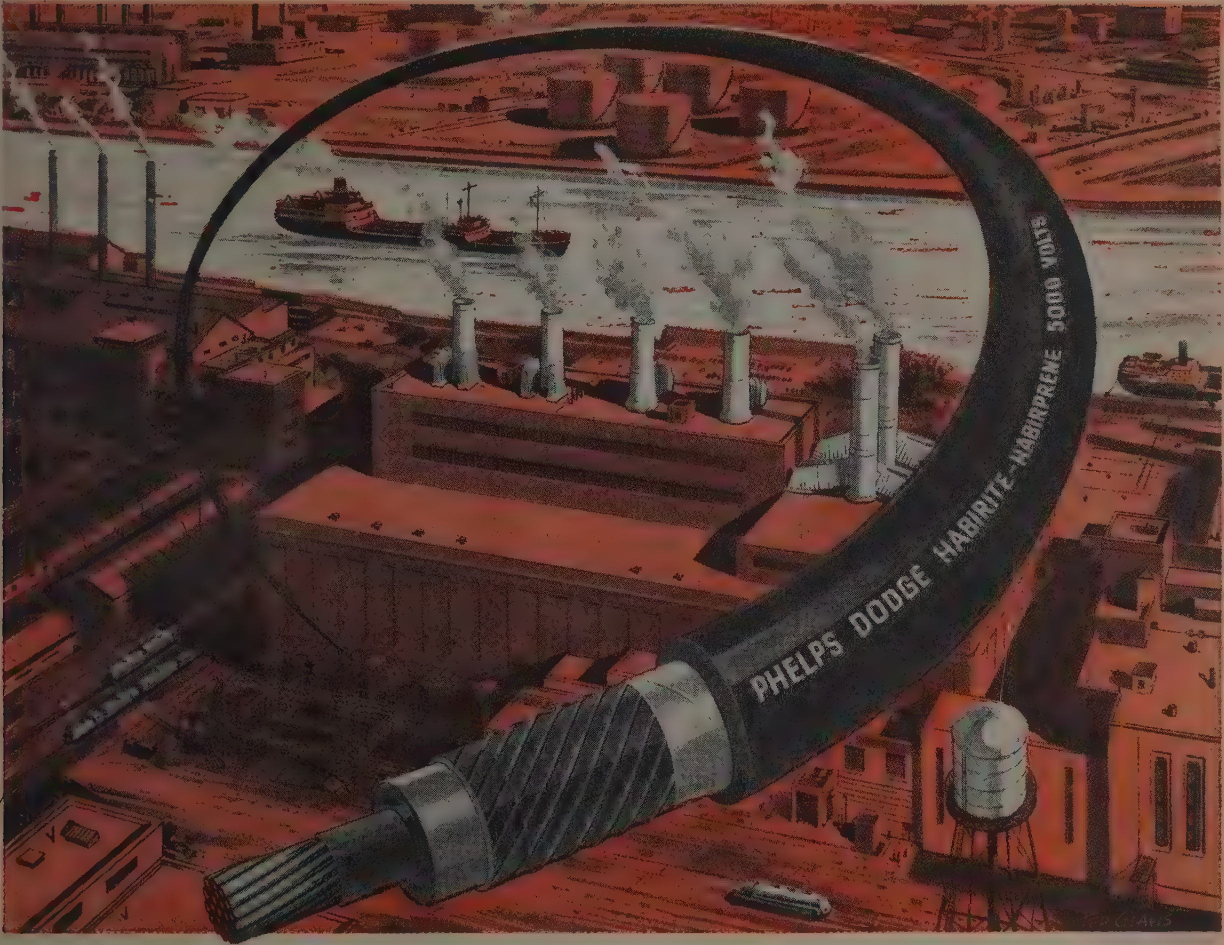
First we wanted to give you stored energy closing. No circuit breaker in this class can really be called modern today without this feature. It insures that you can have fast, uniform closing every time. In fact, I-T-E makes it possible for you to close the breaker even during emergencies when you have lost control power. Fast closing reduces breaker upkeep—prolongs contact life. And I-T-E's motor-driven spring charging mechanism needs only about one-tenth the power of other devices. So you can enjoy the economy of a smaller battery or control transformer.

To give you still greater safety too—again with no increase in cost—we designed this switchgear so you never need open the doors to move the breakers. You can go all the way from connected through test position, to disconnected, and back again with the door closed. Where else can you find safety like this in metal-clad switchgear? Even an inexperienced man can operate it in complete safety. Because we were designing this equipment completely new from the ground up, we had the opportunity to make the components more accessible and provided more elbow room inside the compartments. The bus is higher, for example, making installation and inspection easier. The control cables are brought in at the front for convenience and safe access away from the high-voltage bus. The current transformers are located behind the shutter in the circuit breaker compartment and may be easily changed without disassembling the bus or cable connections.

We were meticulous from the beginning about taking full advantage of the many new materials now available for switchgear use. And through careful selection of materials, skillful arrangement of components, and shrewd economy of space, we were able to give you all these advances in a substantially smaller package as standard equipment. The gear fits under lower overheads and in narrower aisles. Yet it gives you actually more usable space inside than you had before. Circuit breakers are lower, lighter and easier to handle. Instruments are at eye level. We believe you will agree there is no finer switchgear available today anywhere.

A complete description of this equipment is contained in our new illustrated Bulletin 2801-2A. Send for your copy. And ask to see our new sound strip film. We'll bring it to your office. You can see it in 18 minutes. I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

WHEN ORDERING "TYPE RR" CABLE...



SPECIFY HABIRITE-HABIRPRENE

The high voltage cable that assures superior quality and service reliability!

The term "RR" is only a name, not an assurance of quality. Instead of ordering just "RR" cable, insist on Phelps Dodge *Habirite-Habirprene*—developed through years of experience in designing and manufacturing this type of cable.

Phelps Dodge Habirite insulation, a specially engineered butyl rubber compound, has a service dependability record unsurpassed by other types of rubber insulation. Habirite is greatly superior to old-fashioned insulation for these reasons:

- Much greater resistance to heat and oxidation which permits a higher temperature rating, with consequent reduction in conductor size and in cost for same current load.
- Much greater resistance to ozone usually present around high voltage equipment.
- Better electrical properties that give a greater safety factor in operation.

Phelps Dodge Habirprene sheath, a neoprene compound with improved mechanical toughness against damage from installation hazards, is especially made to be extra resistant to corona, one of the worst enemies of high voltage cable. This extra resistance provides a greater safety factor in operation and has contributed to the remarkable reputation and service record of *Habirite-Habirprene.*

When you specify *Habirite-Habirprene*, you are assured of high voltage cable with the utmost in safety and durability. *See your Phelps Dodge Distributor!*

PHELPS DODGE COPPER PRODUCTS
CORPORATION

SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Denver, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Tampa, Washington, D. C.

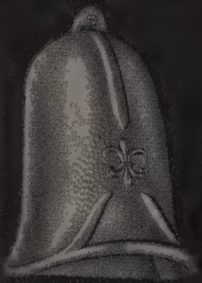
EXPLOSION-PROOF

Killark explosion-proof light fixtures provide approved protection for Class 1, Groups C and D, Class 2, Groups E, F, G installations. Special inner reflector plays important part in excellent lighting efficiency. Pendant, ceiling, bracket and flush mountings. Shock-proof, heat-resistant annealed globe. 60 to 500 watt.

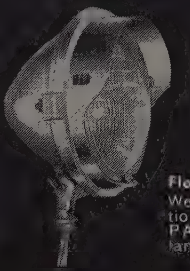
DUST-TIGHT

Approved light fixtures for use in Class 2, Groups E, F, G hazardous locations. Vertical design keeps dust from accumulating, close fitting parts keep it from entering fixture. Coolest burning dust-tight lights mean added safety. 100 and 150-300 watt sizes.

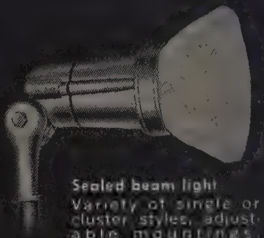
SPECIAL LOCATIONS



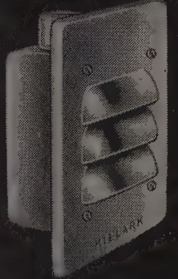
Conch light
Many applications—indoors or outdoors. Attractive fleur-de-lis design. With or without switch.



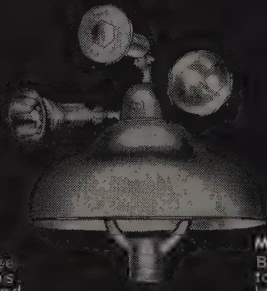
Flood light
Weather proof in any position. Styles for PAR-56 and PAR-64 sealed beam lamps.



Sealed beam light
Variety of single or cluster styles, adjustable mountings. Sealed against weather. PAR-38 and R-40 lamp styles.



Louver light
For steps, passage ways, small signs. Easily installed and serviced.



Mushroom island light
Basic island light, plus one to five sealed beam spot lights, as required. Ideal for service stations, parking lots, etc.

Dekorative light
Gives added beauty. Pendant or ceiling mounting; frosted or clear globe. 60 100 and 150 watt lamps.

Killark

ELECTRIC MANUFACTURING CO.
Vandeventer and Easton Ave. • St. Louis, Missouri
In Canada: Killark Electric of Canada, Ltd., 421 Islington Ave. South, Toronto 18, Ont.

Wherever protected illumination is needed...

KILLARK LIGHT FIXTURES SERVE WITH DEPENDABILITY

A complete line of industrial and commercial lighting fixtures allows Killark to serve all types of installations with proper protected lighting. The Killark ability to supply exact needs means maximum safety, convenience, and efficiency—for both hazardous and non-hazardous locations.

All Killark fixtures are cast from aluminum to provide important extra advantages. Installed inside or outdoors, they remain permanently rust-proof. They give outstanding service in many areas where corrosion is a problem. Aluminum also dissipates heat at a much faster rate, and is safer because it's non-sparking.

Simplicity of design is still another reason for the superior performance of Killark light fixtures. Most styles have interchangeable parts to allow quick, inexpensive changes in mounting method, wattage capacity, type of globe, or reflector. Relamping can be done easily without tools.

Your Killark dealer can supply these fine light fixtures promptly—from his stock or one of the nineteen Killark warehouses in the United States and Canada.

Killark light fixtures are U.L. and C.S.A. approved.

VAPOR-TIGHT

The Killark line has vapor tight light fixtures for every outdoor or indoor need. Design simplicity and interchangeable parts makes these lights easy to install and service. Positively weather proof. Pendant, ceiling, bracket mountings 60 to 500 watt.

ACCESSORIES

Write for the Killark lighting catalogs.

SOLD THROUGH WHOLESALERS FROM COAST TO COAST AND IN CANADA. WAREHOUSE STOCKS IN NINETEEN CITIES.

6025

Mr. Simpson in front of Pittsburgh building where G-E Remote-Control Wiring saves $700-$800 a year.

"G-E Remote Control Switching solved a 33-story problem for us!"

. . . Mr. T. J. Simpson, Assistant Superintendent Grant Building, Pittsburgh, Pa.

"Control of corridor lighting used to cost us too much money," says Mr. Simpson "because of a floor-by-floor manual switching system.

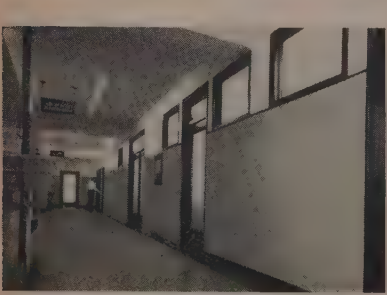
"A man had to make as many as four 33-floor trips a day to turn lights ON and OFF. Even at that, lights were ON overtime.

"Then we discovered G-E Remote-Control switching. You can say it solved a 33-story problem for us!

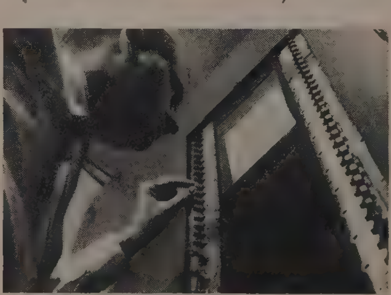
"We installed two 24-volt switches on the first floor to control G-E relays, bridged across corridor light switches, on thirty-three floors. Pressing one or both of these General Electric switches instantly turns lights ON or OFF on every floor.

"The 24-volt control circuit runs in an old conduit; we didn't have to tear up the place. It was the only practical way to do this job. Easy and inexpensive!"

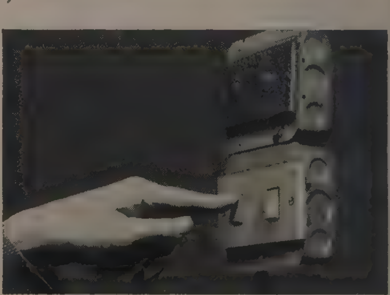
General Electric Company, Wiring Device Department, Providence 7, Rhode Island.



Each corridor has two sets of controlled lights — one ON every day — one near windows, ON when its dark outside.



Old system controlling corridor lights required manual operation of panel switches on 33 floors. A half-hour job!



New General Electric Remote-Control switches control selected lights on all 33 floors at once, from one spot.

Progress Is Our Most Important Product

GENERAL ELECTRIC

In Theory Anyone Can Make Lighting Fixtures to RLM Standards

BUT

only RLM-Labeled fixtures are guaranteed to meet these standards, a guarantee made possible only by both the MANUFACTURER and the Certification Program of THE ELECTRICAL TESTING LABORATORIES

You often hear the question, "Is it equal to RLM?"... or you see in specifications the words: "RLM or Equal"... of course, theoretically it is possible to meet RLM Specifications. It is in the *guarantee* that the RLM Label cannot be equaled! The heart of the RLM Label is in its warranty of conformance to these RLM Specifications. This guarantee of the manufacturer to buyers is based not on specially submitted samples to a laboratory or an outdated test... but on a continuous, current testing and certification program conducted by the independent and world famous ELECTRICAL TESTING LABORATORIES OF NEW YORK.

THE FINAL INGREDIENT OF BEING SURE

INCANDESCENT RLM SPECIFICATIONS

#1 100-1000w Dome	#2 100-1000w Deep Bowl	#3 100-1000w Sym. Angle	#4 500-1000-400MV High Bay	#18 200-1000w Glassteel Diffuser	#40 500-1000-400MV 1000MV High Bay*	#41 400-1000MV Semi-Direct High Bay*	
4	2	1	2		3		ABOLITE
4	4	2		1			APPLETON
5	4	4					BENJAMIN
5	1						ELECTRO
4			2				MILLER
4			3		3		MULTI
4	4	3					OVERBAGH & AYRES
6	4	6	3	2	2		QUADRANGLE
5	3	3					[redacted]
4	1		1				SPERO
5		2	2		4	2	STEBER
4	1	1			1		WAKEFIELD
5	4	2		2			[redacted]
5	4	1					WHEELER-FULLERTON

*Aluminum Reflectors all others are Porcelain Enamel

FLUORESCENT RLM SPECIFICATIONS

UPLIGHT → 8-20% → 10-20% → 20-30%

D-1 2-40w 1A 1B	D-1 2-75w 1D	D-1 2-800 ma. 1E	D-2 3-40w 2A-2B	D-2 3-75w 2D	D-2 3-800 ma. 2E	D-3 2-90 & 40w 3A 3B	D-4 2-1500 ma.	SD-1 2-40w 1A-1B	SD-1 2-75w 1D	SD-1 2-800 ma. 1E	
✓	✓	✓	✓	✓	✓			✓		✓	BENJAMIN
✓	✓	✓	✓	✓	✓			✓	✓	✓	CURTIS-ALLBRITE
✓		✓	✓			✓		✓	✓	✓	ELECTRO
✓	✓		✓								ENDER-MONARCH
✓	✓	✓	✓	✓	✓			✓	✓		KEYSTONE
								✓		✓	LIGHTING DYNAMICS
✓											MULTI
✓	✓	✓	✓	✓				✓			RUBY-PHILITE
✓	✓	✓	✓	✓	✓			✓	✓	✓	SMOOT-HOLMAN
✓	✓	✓	✓	✓	✓			✓	✓	✓	SUNBEAM
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	SYLVANIA
✓	✓	✓									WAKEFIELD
✓	✓	✓	✓	✓	✓			✓	✓	✓	WESTINGHOUSE
✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		WHEELER-FULLERTON
✓	✓	✓	✓	✓	✓						WORK-O-LITE

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LOOK FOR MANUFACTURER'S NAME HERE

RLM

ELECTRICAL TESTING LABORATORIES, INC.

Types of RLM-Labeled equipment available from each of the 22 participating manufacturers is shown in the chart.

PRODUCT QUALITY
LIGHTING QUALITY

These TWIN QQ's to Industrial Lighting Success are guaranteed with all lighting equipment bearing the RLM Label. Write for FREE RLM Specifications Book.

RLM STANDARDS INSTITUTE, INC.,
Suite 819N, 326 West Madison Street, Chicago 6, Illinois

TO CORNER more new electrical contracts...of the kind and size you want, you need advance news on jobs coming up—so you can concentrate on those that are best for you. You need daily Dodge Reports!!

DODGE REPORTS are individual building project reports. They're mailed to you daily. You get REPORTS on just the types of building you're interested in. They tell who's going to build what and where ...whom to see...when bids are wanted...who else is bidding...who gets which awards.

When you use DODGE REPORTS, you always know what's coming up. You don't depend only on invitations to bid. You concentrate on jobs you know will be profitable.

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Send me the book: "How Subcontractors Get More Work in New Construction" and let me see some typical Dodge Reports. I am interested in the general markets checked below.

☐ House Construction ☐ General Building
☐ Engineering Projects (Heavy Construction)

Area ____________________
Name ____________________
Company ____________________
Address ____________________
City ____________ Zone ________ State ____________

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CORPORATION

Dodge Reports

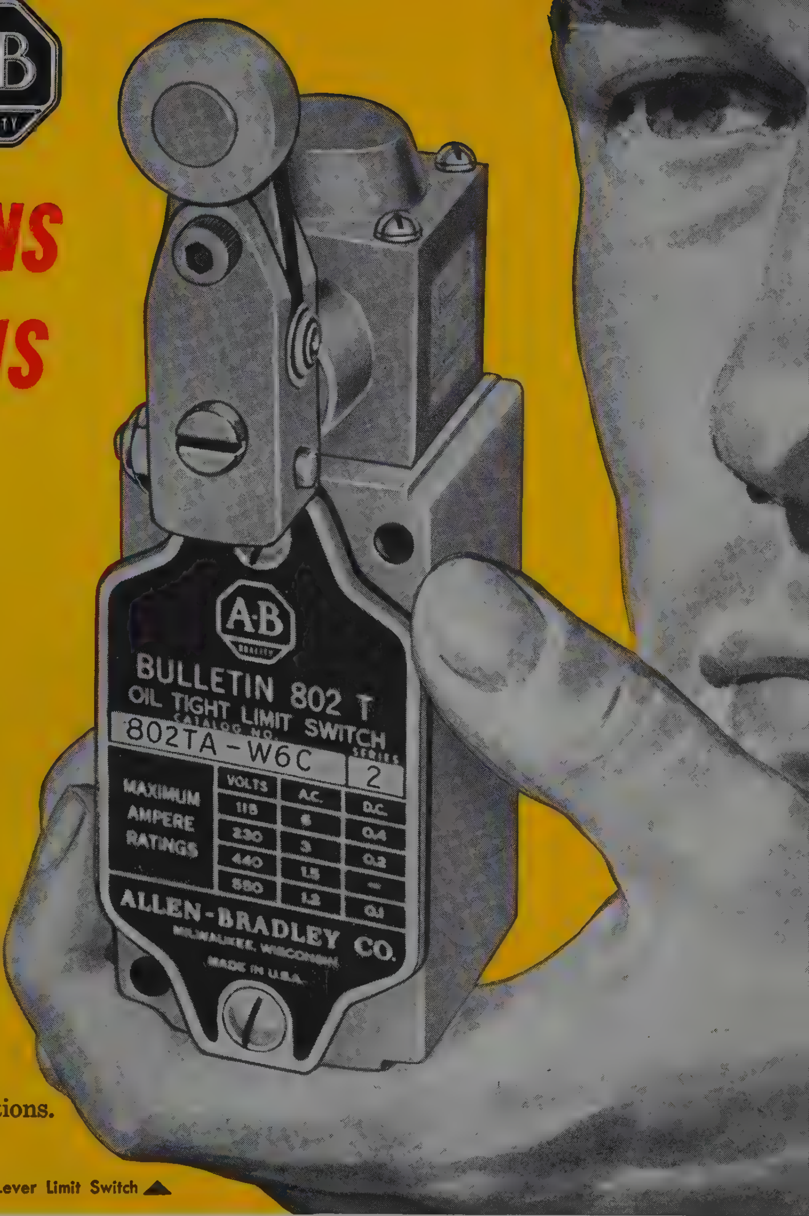
HELP
ELECTRICAL CONTRACTORS
GET MORE BUSINESS

MORE MILLIONS OF OPERATIONS

with Allen-Bradley Limit Switches

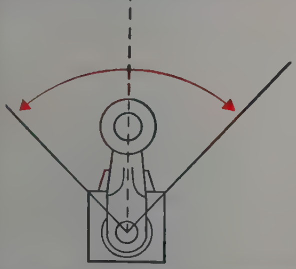
There's nothing now on the market to match the reliability and trouble free performance of Allen-Bradley Bulletin 802T limit switches. They are completely oiltight—operating heads and switch bodies are sealed against oils, coolants, and metal chips. Operators cannot become sluggish or "stick" in operation—contacts cannot become fouled. The double break, silver contacts are always in perfect operating condition—and remain so without maintenance.

Insist on Allen-Bradley—the *quality* line of limit switches that will give you *many more millions* of trouble free operations.

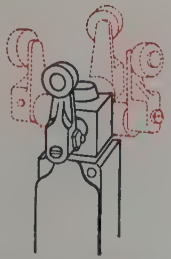


Bulletin 802T Micrometer Adjustment Roller Lever Limit Switch ▲

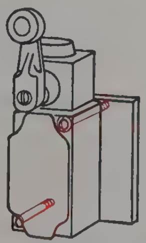
A-B Limit Switch features mean more life, more dependable trouble free service



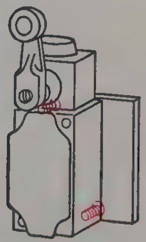
REPETITIVE ACCURACY—Unique toggle blade action assures operation at precisely the same point each time, without adjustment.



FLEXIBILITY—All operating heads can be rotated and fastened in any of four positions 90° apart.



FRONT MOUNTING



REAR MOUNTING

All Allen-Bradley Limit Switches can be mounted either from the front . . . or from the rear.

25-60-M

ALLEN-BRADLEY

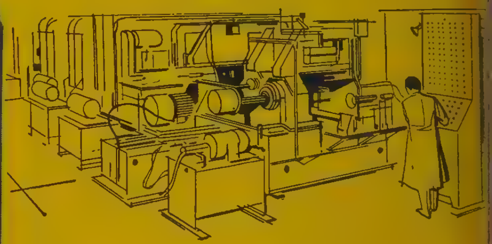
Member of NEMA

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis. • In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL

AUTOMATION BEGINS HERE

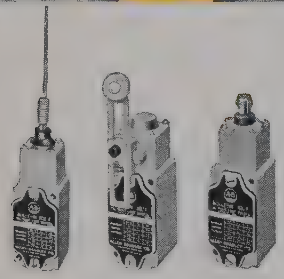
. . . Insist on Allen-Bradley accessories for continuous automatic production



In this broad line of Allen-Bradley accessories, each and every unit carries the traditional A-B trademark of *quality* that stands for trouble free operation. Rugged construction, and maintenance free, silver alloy contacts provide the reliability that is essential to the continuous operation of *your* automatic production machines.

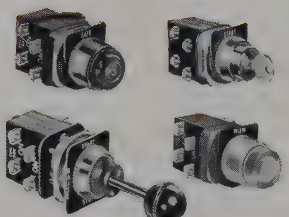
Profit from the experience of the leading machine tool builders . . . insist on Allen-Bradley *quality* motor control *all the way!*

▲ Special push button panels can be assembled to your specifications.

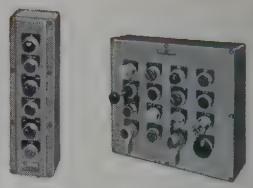


OILTIGHT LIMIT SWITCHES
Bulletin 802T with sealed heads and bodies. Various operators.

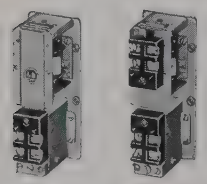
PRECISION LIMIT SWITCH
Bulletin 802 oiltight. Responds to very small operator travel.



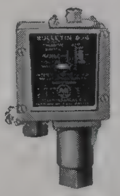
OILTIGHT CONTROL UNITS
Bulletin 800T. Choice of push buttons, lights, and switches.



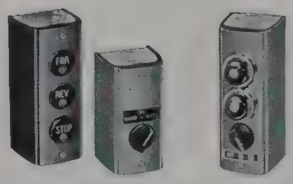
OILTIGHT CONTROL STATIONS
Bulletin 800T for up to 16 units in die cast aluminum enclosure.



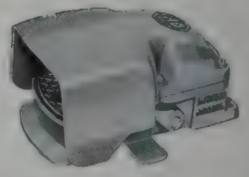
PNEUMATIC TIMERS
Bulletin 849. Reliable and accurate. For on-delay or off-delay.



OILTIGHT PRESSURE CONTROL
Bulletin 836. For hydraulic systems with pressures to 5000 psi.



STANDARD DUTY PUSH BUTTONS
Bulletin 800. Up to three units, also pilot lights and switches.



FOOT SWITCH
Bulletin 805. In rugged die cast housing for toughest service.

25-60-M

ALLEN-BRADLEY

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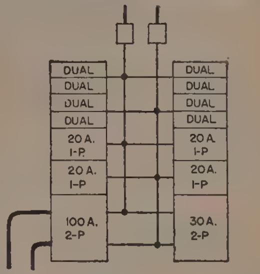
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

QUALITY MOTOR CONTROL

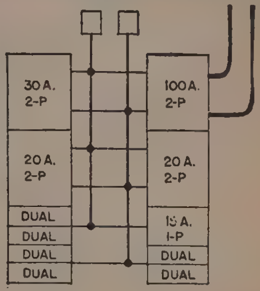
I-T-E
Uni-Pak
PANELS

FLEXIBILITY

AS A BRANCH OR SUBFEED



AS A MAIN DISCONNECT



AND NOW: 100 amp 2-POLE THAT TAKES ONLY 2 SPACES

Now . . . the EQ-P 2-pole 100 amp circuit breaker is available to make the Uni-Pak loadcenter even more flexible than ever. It is the *first* and only plug-in 100A 2-pole that takes up *only two pole spaces!*

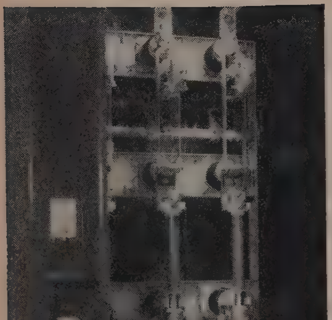
I-T-E plug-in circuit breakers plus the I-T-E Uni-Pak give you the best and most flexible loadcenter line available today. Dual rated Uni-Pak loadcenters plus the 100A 2-pole allow you to convert the economical main-lugs-only loadcenter to a single main disconnect. In addition, the space saving EQ-P 100A 2-pole allows you more branch circuit space.

For additional information, write I-T-E Circuit Breaker Company, Walker Division, 125 Bennett Street, N. W., Atlanta 9, Ga. Ask for Bulletin NI-100.

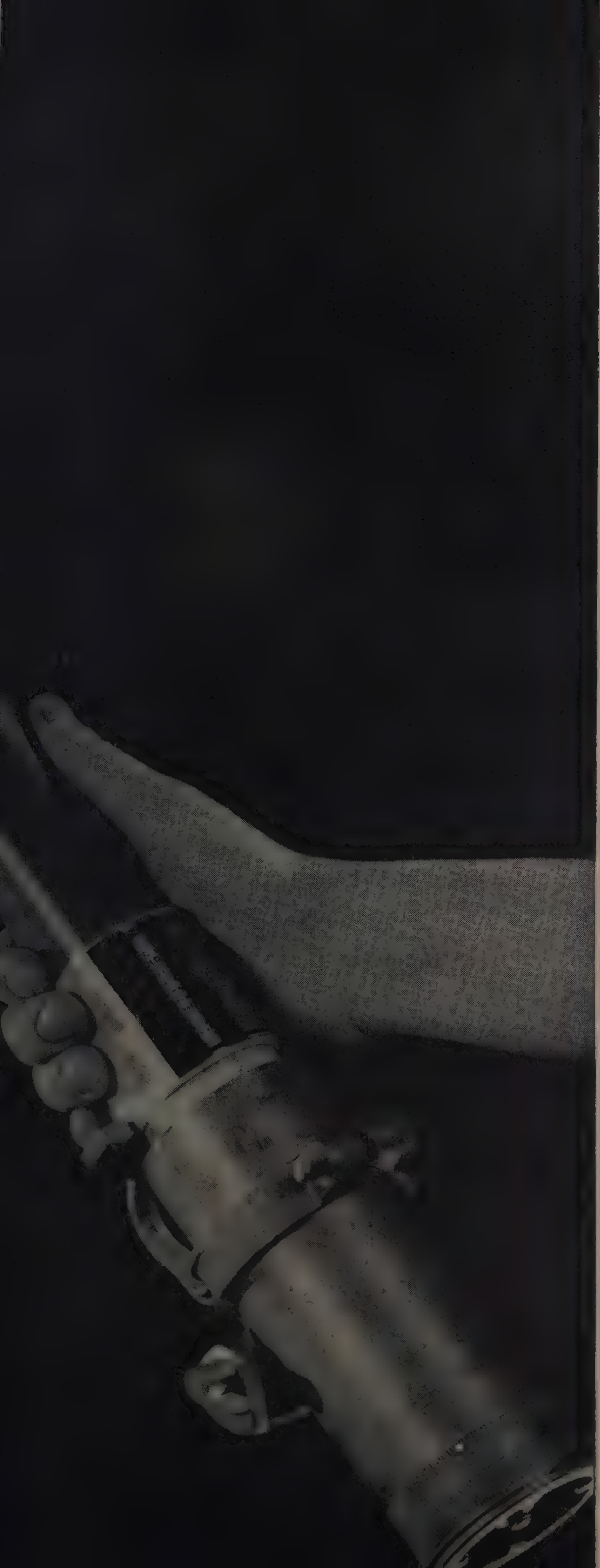
I-T-E

I-T-E CIRCUIT BREAKER COMPANY
WALKER DIVISION

SEES ALL YOUR FAULTS



Inside view of typical bay, showing load interrupter (for switching), power fuses, and out-going pothead.



A Power Fuse both senses and clears short circuits—cuts cost of metalclad switchgear 50%

With S&C Metalclad Switchgear you get dependable protection for your high-voltage power circuits at about half the cost. How? Partly through the use of S&C Power Fuses instead of circuit breakers and relaying.

The power fuse is self-sufficient. It needs no instrument transformers, no relay. There is nothing to set, adjust, test, or maintain. You don't need special equipment or skills. After the fuse clears the fault and the cause has been corrected, you simply reach for a $13.50 refill stored in the compartment door.

Power fuses give you the protection you need against permanent destructive faults. Industrial and commercial high-voltage power circuits are not subject to transient faults (such as lightning, falling trees, wind, ice, rodents) and so don't need the automatic reclosing feature of the circuit breaker.

S&C fused interrupter gear meets the new National Electrical Code requirements for fault closing. It is available in short circuit interrupting ratings up to 500 mva at 14.4 kv, 250 mva at 4.16 kv. Continuous current ratings are 200, 400, and 720 amperes. Maximum capacity of main bus, 2000 amperes.

S & C ELECTRIC COMPANY

4433 Ravenswood Avenue • Chicago 40, Illinois

Specialists in High Voltage Circuit Interruption since 1911

Industry-proved through a quarter century of service...**THERE'S NO DOUBT ABOUT NEOPRENE**

One of American Airlines' fleet of Boeing 707 jet flagships parks at new passenger terminal. Neoprene jacketing protects 68,500 feet of underground lighting cable serving the terminal's apron.

Dependable neoprene jacketed cable lights the apron of another new Idlewild terminal

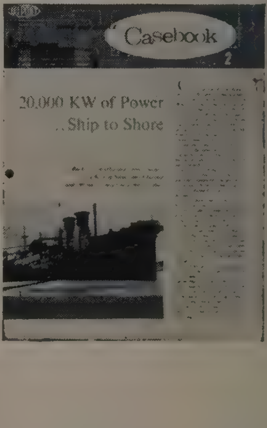
Marshy soil at New York International Airport poses special problems for underground power cable. Excessive moisture that collects in ducts makes life tough for ordinary jacketing. That's one reason why neoprene jacketed cable has been a standard at Idlewild for years. One of the most recent installations is at American Airlines' new jet-age passenger terminal. Here all underground lighting cable serving the terminal apron is protected with durable neoprene jackets, specially compounded for maximum water resistance.

Neoprene jacketed cable has thoroughly proved itself at Idlewild, as elsewhere. Just in the last two years, over 500,000 feet of neoprene cable has been installed during construction work at other Idlewild terminals . . . and all this is in addition to the uncounted millions of feet that have been buried at Idlewild since the airport's inception in 1942.

Neoprene jacketing's proven resistance to weathering, abuse, temperature extremes, flame, hot and cold flow can mean economical *long term* protection for the cable you use. E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Dept. EC-11, Wilmington 98, Del.

Free—Du Pont's new WIRE AND CABLE CASEBOOK

Each issue contains case histories from the electrical industry on the use of neoprene jacketed cables. Subscriptions free on request.



DU PONT
REG. U. S. PAT. OFF.

NEOPRENE
SYNTHETIC RUBBER

Better Things for Better Living . . . *through Chemistry*

ASCO low voltage Remote Control Switches decrease installation costs increase safety, permissible line run

ASCO Remote Control Switches equipped with *low voltage control* are suitable for 24 volt A-C control by push button, time switches, relays or other control methods.

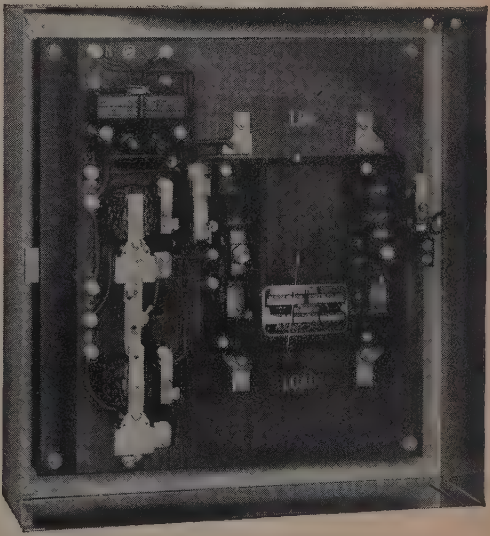
ADVANTAGES

- ***REDUCTION IN COST OF INITIAL INSTALLATION:*** Control equipment can be connected through small wires – no BX or other large cable required. Control components such as push buttons can be inexpensive units: no conduit boxes are needed.
- ***SAFETY:*** Lower voltages provide increased safety for personnel. For schools or any installations where control stations are accessible to the public, the safety advantage of low voltage control is apparent.
- ***INCREASE IN PERMISSIBLE LINE RUN:*** Control wires can be #18 for a maximum distance between control station and switch of 500 feet; Maximum line run for #14 wire is 1300 feet.
- ***ASCO "PACKAGE UNIT" REQUIRES NO EXTERNAL RELAY OR FUSE BOX:*** The Remote Control Switch, Relay, Transformer and Fuse – all the items needed for low voltage control – are on one compact panel.
- ***ADAPTABLE LOW VOLTAGE RELAY PANEL:*** Can be mounted separately from the Bulletin 920 Remote Control Switch. Relay panel includes low voltage control relays with a stepdown transformer.

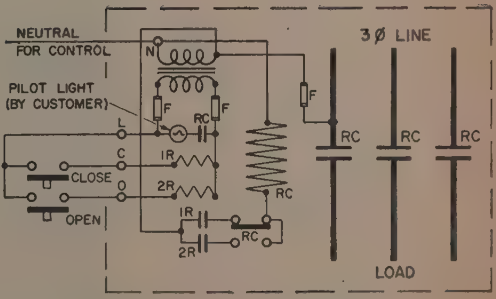
CONSTRUCTION AND OPERATION

Complete panel consists of a Bulletin 920 Switch with fuse adapter, auxiliary contact, and low voltage relay panel. In Circuit Diagram, control is shown from momentary contact control stations, using two normally open momentary contact buttons, one for closing and one for opening. Note that the push buttons are on the low voltage control circuit.

Additional openings and closing buttons can be connected in parallel with buttons shown.



Catalog No. 238SIC, 30 Ampere Bulletin 920 Remote Control Switch with Low Voltage Control.



Elementary Wiring Diagram—Bulletin 920-238 Remote Control Switch for 24 Volt Low Voltage Control.

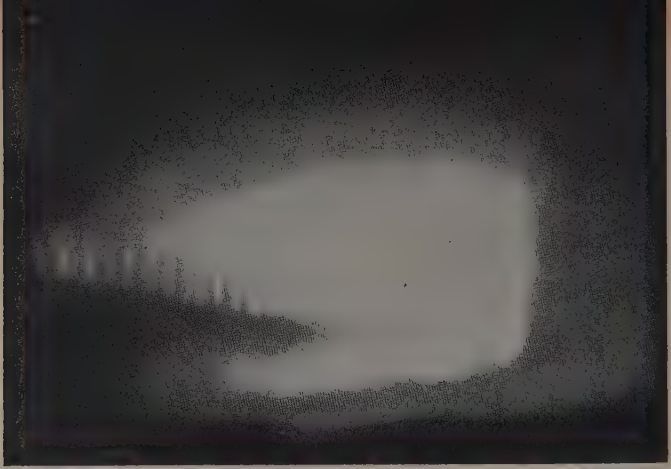
FOR COMPLETE INFORMATION, WRITE FOR BULLETIN 920-238 – OR HAVE THE ASCO ENGINEER CALL.

ASCO Valves

ASCO

Automatic Switch Co. 50-J HANOVER RD., FLORHAM PARK, N. J., FRONTIER 7-4600

AUTOMATIC TRANSFER SWITCHES • SOLENOID VALVES • ELECTROMAGNETIC CONTROL



Corona effect—beautiful to look at

The Aurora Borealis is a spectacular sight to see but it knocks out communication systems all over the world. In high voltage power cables, corona effect or ionization creates ozone which causes rapid deterioration of ordinary rubber insulation.

Years ago, engineers at American Steel & Wire took steps to correct this situation. They developed PS shielding with semi-conducting rubber tape wrapped around the conductor and over the insulation. This eliminated air gaps which might cause spark discharge and provided the best possible contact between conductor and insulation. Semi-conducting rubber shielding has since been adopted by the industry.

Another development, butyl rubber insulation, combines outstanding resistance to the effects of ozone, with heat stability and high moisture resistance.

In USS Tiger Brand Cables, this insulation is known as Amerzone B. It will withstand current loadings resulting in copper temperatures of 90°C.

The combination of PS shielding and Amerzone B insulation in Tiger Brand Cables (5 to 15 KV), plus an Amerprene 90 cover, provides a power cable with outstanding reliability and performance.

Such cables can be used for installation in ducts or for direct burial in earth, for aerial use, and many other high voltage applications. For more information, write for our booklet, "Tiger Brand Power Cables," which covers Amersheath Type RR Cable and Metallic Parkway Cables. Address American Steel & Wire, Dept. 0446, 614 Superior Avenue, N. W., Cleveland 13, Ohio.

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USS Tiger Brand Electrical Wire & Cable—A standard cable for every special job

Asbestos Wire and Cable • Varnished Cambric Cable • Mold-Cured Portable Cord • Interlocked Armor Cable • Shovel & Dredge Cable • Special Purpose Wire & Cable • Paper & Lead Cable • Aerial, Underground and Submarine Cable

USS American Steel & Wire
Division of
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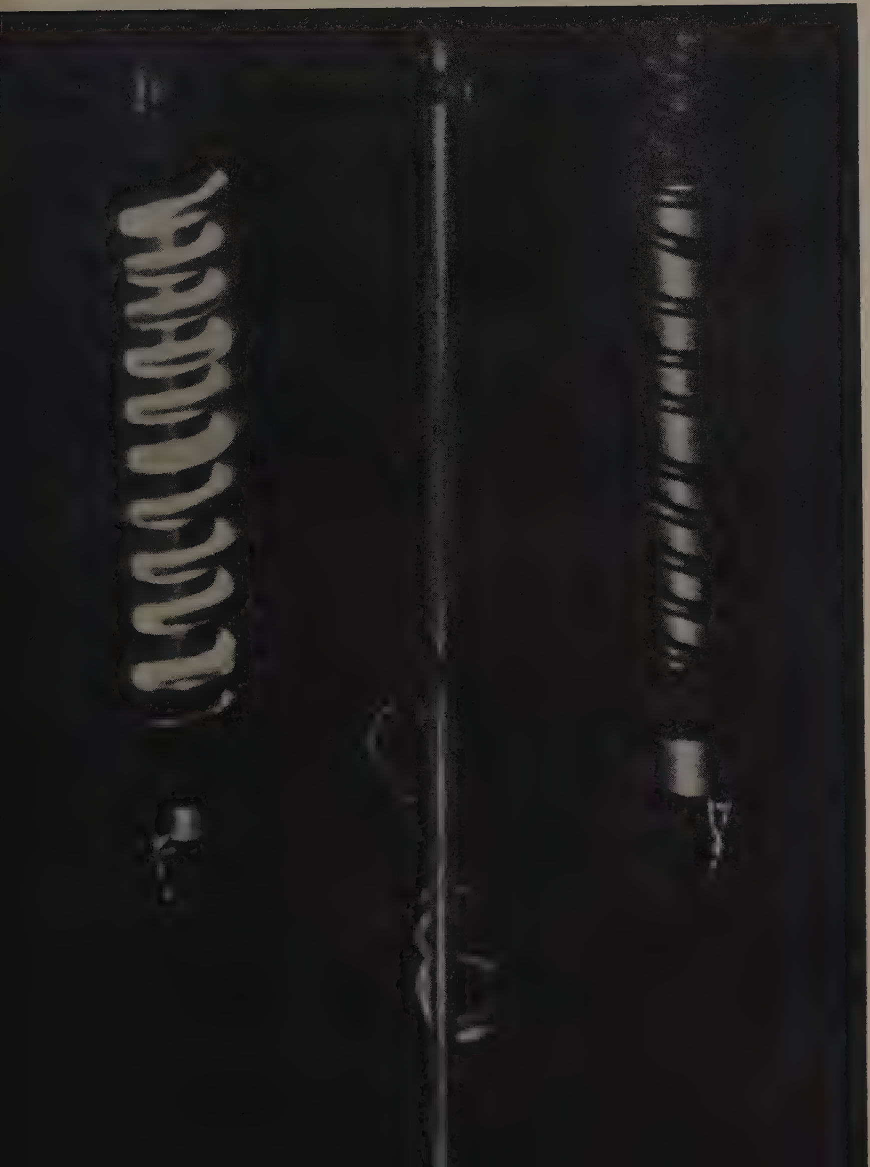
Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad

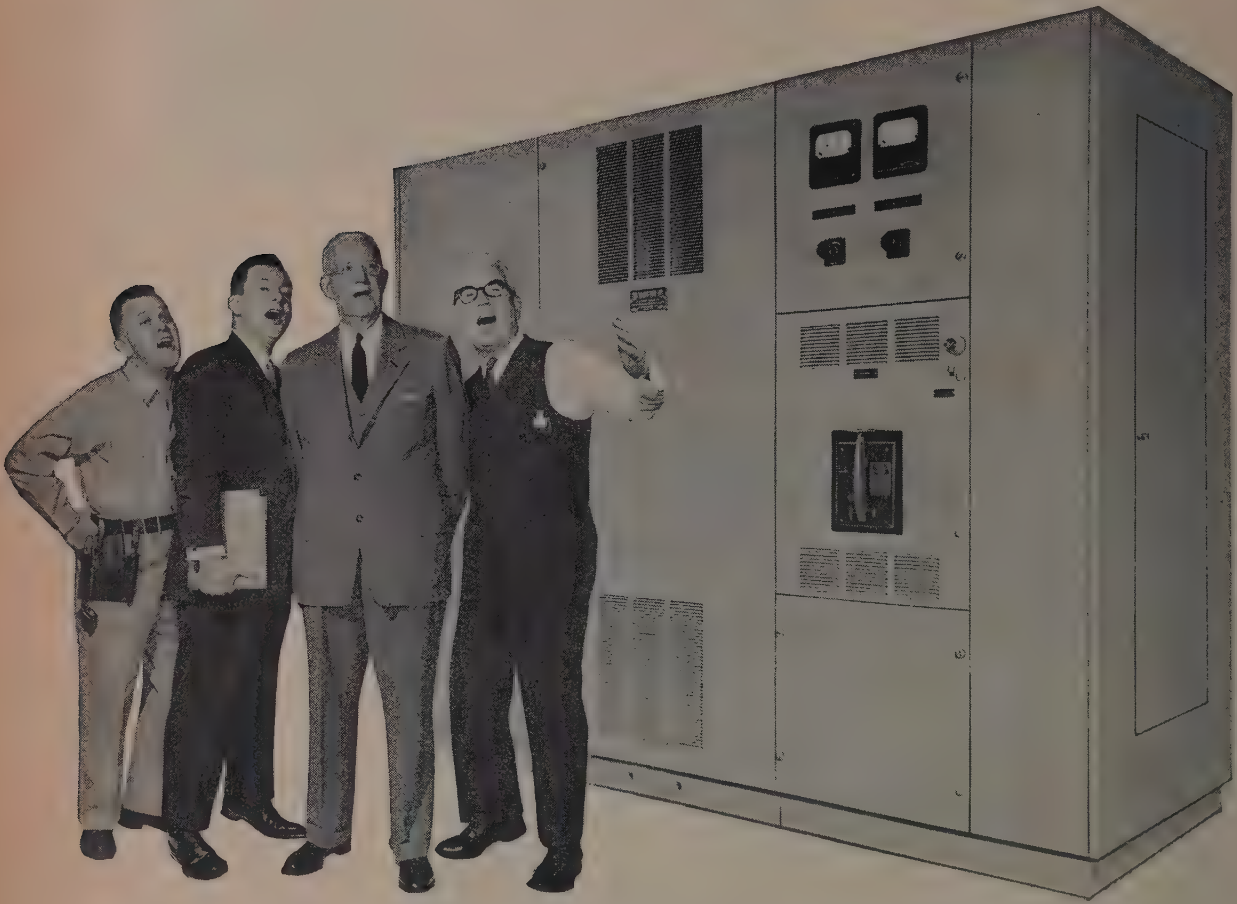
. . but dangerous in cables



Corona eliminated

Test showing two conductors both insulated with "ozone-proof" rubber, but the one on the left is not shielded and shows corona. On the second conductor, Type PS shielding prevents corona formation.

"WE BOUGHT THE I-T-E ♫ ♪ ♪ ♪ TRANFO-UNIT® BECAUSE..."



The Tranfo-Unit is a complete, self-contained unit substation in a single package. It includes the primary disconnect, transformer, and secondary circuit protective devices.

"So easy to install. There's no complicated assembly at the site. You just position the Tranfo-Unit and connect."

"Neat, attractive appearance. No hodge-podge arrangement of assorted gear. Saves space too. A real asset for any building."

"Greater safety. Everything is inside the Tranfo-Unit. No exposed hot parts. It needs no fence."

"Better regulation. We put a Tranfo-Unit in every load area. So we get better voltage regulation for all our lights and equipment."

"Economy. We buy our power at economical higher voltages. Then we put the Tranfo-Unit right near the load. Cables can be smaller size, lower cost."

"Flexibility. I-T-E gives us complete custom design service. Tranfo-Unit components can be selected to meet our particular requirements."

For supermarkets, schools, office buildings, factories and many other applications, the I-T-E Tranfo-Unit is ideal. Available from 45 through 2500 kva. For complete information, write I-T-E Circuit Breaker Company, Dept. TR, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

60TH YEAR • NOVEMBER, 1960

ELECTRICAL CONSTRUCTION AND MAINTENANCE

COLOR, a new dimension in lighting

Effective lighting application depends critically upon scientific criteria, such as intensity and brightness, which are objectively measurable. Direction, diffusion and shielding also play important roles. Such characteristics of lighting installations are well known and usually carefully considered in practical installations. But color, obviously among the most significant aspects of the visual environment, if it is considered at all, is usually identified by lighting people only in terms of the reflectance of surfaces.

Throughout our lives and in every visual environment the color of things is vital for intelligent identification and comprehension. But the colors we see are only those which our lighting sources can render. Thus color and incident light are closely interdependent in creating the visual environments so important to our comfort, security and effectiveness.

Much has been done by lighting engineers in the field of specialized lighting systems to meet critical problems of close color discrimination; for matching dyes, grading cotton, appraising furs and many other industrial and commercial tasks. Stage lighting experts also regularly produce an infinite variety of spectacular and esthetic effects. But little of all this valuable experience has been applied to the practical areas of industrial, commercial and residential lighting.

It was only a few years ago that higher illumination levels, such as 100 footcandles and above, were applied only to very special tasks or purposes which could not be accomplished practically otherwise. The higher intensities were not then considered feasible for conventional applications. But we now know that general lighting in the range above 100 footcandles is very beneficial indeed for such routine general lighting applications as office work, merchandise display or even for the home kitchen.

Logically, progress toward superior quality in lighting application must compel more critical attention to color perception and discrimination not only for particular seeing tasks but for the whole visual environment. Such further sophistication in lighting application does not lead, as some may believe, only to a universal standard white light. It also leads to deliberate bias, in the selection of sources and controls, to enhance or suppress portions of the spectrum for particular objectives.

Consideration of color effects in the design of lighting systems promises to be a dynamic new dimension of practical lighting application. To achieve superior visual performance in optimum visual environments will almost certainly require substantially higher energy and lumen input to the lighting system than we have so far employed in common practice.

Wm. T. Stuart

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8 reasons why you get more light per dollar

General Electric *PREFERRED LIGHTING* is based on a simplified line of outdoor-lighting products which actual purchases show most customers prefer. Here are 8 ways *PREFERRED LIGHTING* adds up to more light per dollar on your streets and highways:

- A full selection of modern, fast-moving equipment.
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- Reduced inventories for you . . . G.E. does the stocking.
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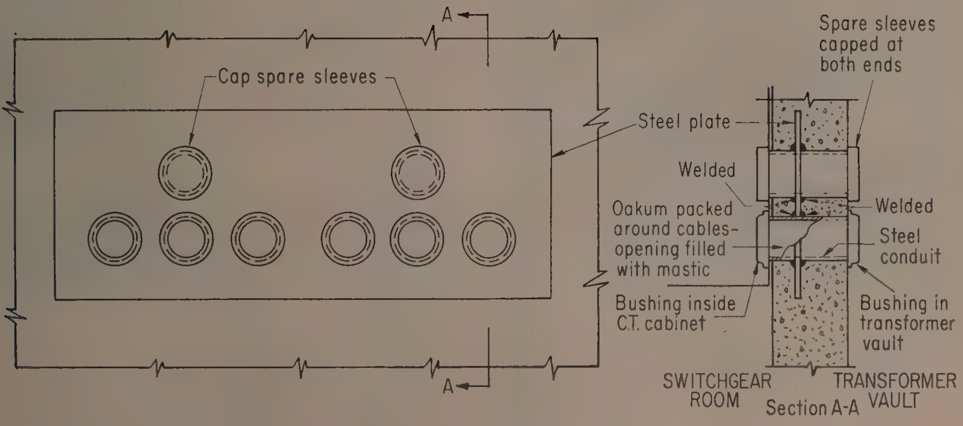
For full data on *PREFERRED LIGHTING*, see your G-E Apparatus Sales Engineer or Agent now. And write to General Electric Co., Section 460-09, Schenectady, N. Y. for the 28-page "Designer's and Buyer's Guide to *PREFERRED LIGHTING*" (GEA-7100). Outdoor Lighting Dept., Hendersonville, N. C.

General Electric's famous "Crossroads of Light," Hendersonville, N. C., lighting demonstration area for your use.

Progress Is Our Most Important Product

GENERAL ELECTRIC


A
Cap spare sleeves
Steel plate
A
Spare sleeves capped at both ends
Welded
Oakum packed around cables-opening filled with mastic
Welded
Steel conduit
Bushing inside C.T. cabinet
Bushing in transformer vault
SWITCHGEAR ROOM
Section A-A
TRANSFORMER VAULT

WATERPROOF CONSTRUCTION is used for the steel plate through which service conductors pass from the utility vault to the CT cabinets.

Design and construction details for . . .

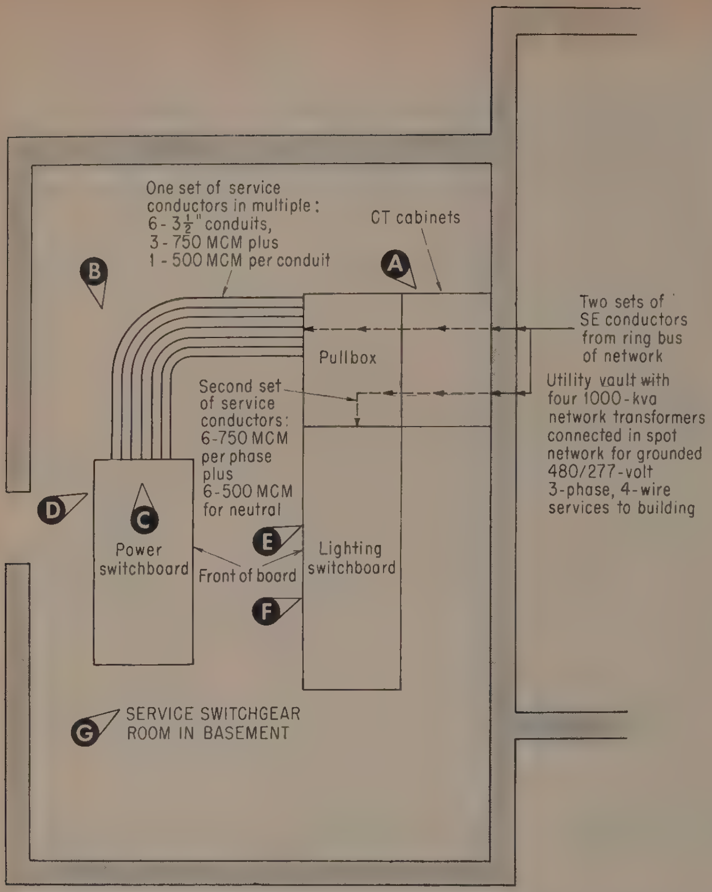
480/277 Volts in an Office Building

A close look at the modern electrical installation serving light and power loads in Gateway Center No. 4—another building in the dynamic expansion of downtown Pittsburgh, Pa. Electrical design was done by Meyer, Strong and Jones, New York City. Frame Electric Company, Pittsburgh, made the installation.

By J. F. McPartland

A COMPACT, but flexible, electrical system is the major functional element in Gateway No. 4, one of Pittsburgh's newest office buildings. Here, electrical design followed highly practical concepts, affording maximum return in power and light utilization for the money invested in the overall system. High capacity circuits with substantial margins for load growth, selectively coordinated overcurrent devices for increased system reliability, cellular floor raceway and grid layout of lighting circuit conduits to meet varying tenant requirements and pipe and wire feeders with economy-minded makeup and loading—these are some of the interesting design details. And construction of the system entailed a wealth of modern installation techniques.

Power for the 22-story building originates from four 1000-kva utility network transformers forming a spot network in an underground vault adjacent to a switchgear room in the basement at one corner of the building. Two sets of service feeders deliver energy at 480/277 volts, 3-phase, 4-wire, grounded wye. Each service feeder is made up of six 750 MCM conductors per phase and six 500 MCM conductors for the grounded neutral, and each


One set of service conductors in multiple: 6 - 3½" conduits, 3 - 750 MCM plus 1 - 500 MCM per conduit
CT cabinets
A
B
Two sets of SE conductors from ring bus of network
Pullbox
Second set of service conductors: 6-750 MCM per phase plus 6-500 MCM for neutral
Utility vault with four 1000-kva network transformers connected in spot network for grounded 480/277-volt 3-phase, 4-wire services to building
D
C
Power switchboard
Front of board
E
Lighting switchboard
F
G
SERVICE SWITCHGEAR ROOM IN BASEMENT

EQUIPMENT LAYOUT in service switchgear room shows feeds from adjacent transformer vault to building switchboards. Circled letters correspond to accompanying photos of various equipment in the room. Each arrowhead in this plan indicates the angle at which the photo was made.

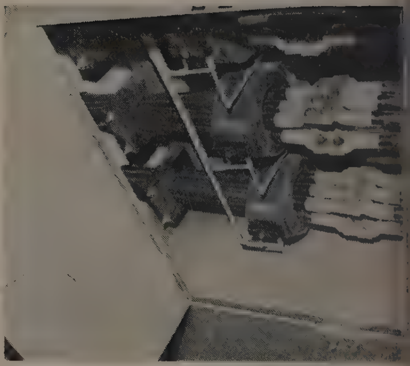


PHOTO A—CURRENT TRANSFORMERS for metering of one of the services are shown through the open doors on the bottom of the cabinet. At left in the cabinet, the service conductors come through the wall from the utility vault.

supplies a floor-standing, safety-enclosed CB switchboard. All electric power for the building is derived from these two switchboards —one board supplying lighting feeders; the other, power feeders.

Each switchboard contains an electrically operated power circuit breaker for main service disconnect and protection. The main CB in each case is rated to trip at 3000 amps and incorporates overload trips—long and short time delays—

PHOTO D—SUPPLY CONNECTIONS to multiple-lug plates for individual phase buses in each switchboard make use of limiter lugs rated 750 MCM to match the conductor size. These lugs are required by the utility as part of its spot-network service hookup.

PHOTO E—POWER CIRCUIT BREAKER in dead-front lighting switchboard is set as shown behind the open panel. Unit is rear-connected to switchboard bus, with current transformers in connection to feed ammeter in top section of the same compartment. Units with top grates are arc chutes for contact assemblies. Pushbutton in front plate permits manual tripping of the electrically-operated CB.

PHOTO F—FUSE BLOCK is shown here removed from one of the combination fuse-CB feeder protective devices. This permits access to the fuse units for changing if necessary. Butt terminals on fuse carriers mate with spring-clamped sockets in CB assembly (through opening in switchboard front). Operation of any fuse trips CB to prevent single-phasing on the feeders.

PHOTO B—SERVICE CONDUITS into power switchboard were bent on the job and terminated with two aluminum locknuts and an aluminum bushing. Ease of bending dictated field bends instead of ells for conduit turns.

PHOTO C—SERVICE CABLES into end wiring compartment of power switchboard divide demand load among six sets of 3-phase, 4-wire feeders. All conductors on this job—including all branch circuit wiring—are type RHW.

as required to provide coordinated operation with the load-side overcurrent devices protecting outgoing feeder runs. High reliability and continuity of service is assured by coordinating devices so that a feeder fault takes out only that feeder and will not operate the main. Careful calculation of selective coordination for all of the protective devices in the feeder system was one part of the detailed engineering done by William Broderick, electrical engineer of Meyer, Strong and Jones.

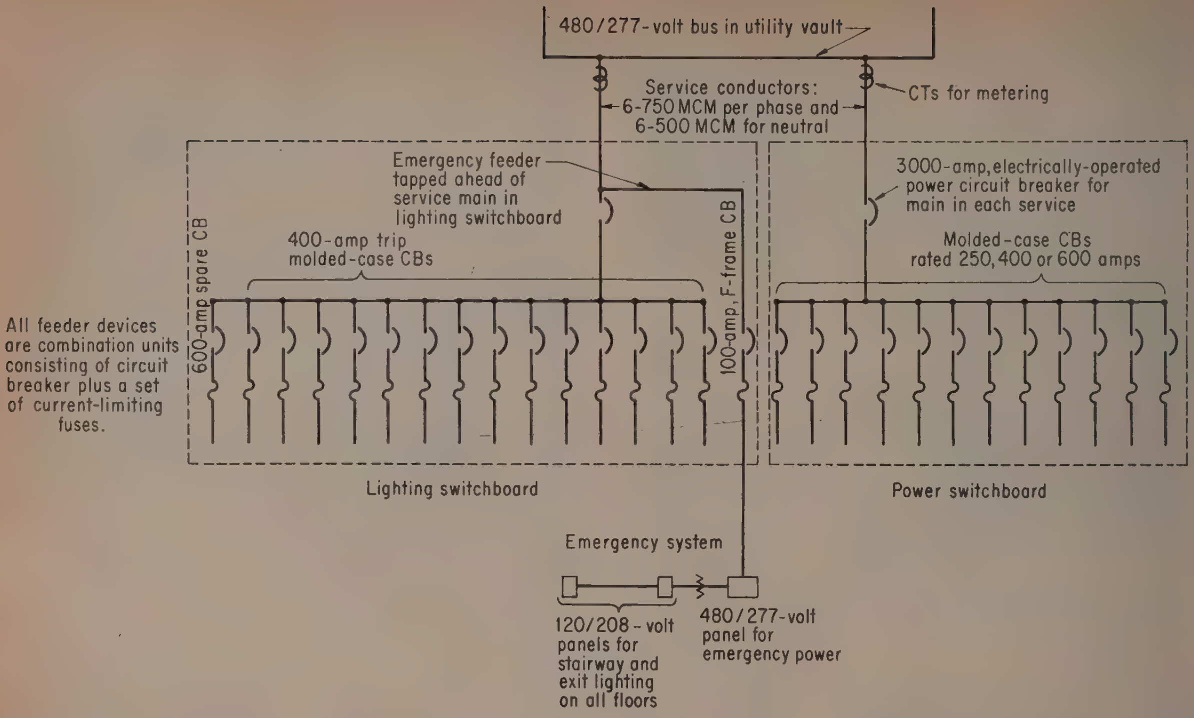
Each main CB has an interrupting rating of 100,000 rms asymmetrical amperes to meet the fault current capability of the supply system at their point of application. The CB is rated to safely and effectively interrupt the highest current which might flow through it (produced by a bolted short on its load terminals). The short-circuit capability of the supply system at the utility vault terminals was given as 87,000 amps symmetrical (about 109,000 amps asymmetrical). Impedance from these terminals to the terminals of the main CB in each switchboard reduced the duty from that value, permitting use of the CBs rated 85,000 symmetrical—100,000 asymmetrical.

Feeders from the two switchboards are carried to panels and control centers for the various loads. From one switchboard, lighting feeders are carried to electric closets on each floor of the building. Feeders from the other switchboard supply power loads in the basement, on the 14th floor and in the roof penthouse mechanical rooms. Design of the feeder riser system aimed at high capacity with simplicity and economy.

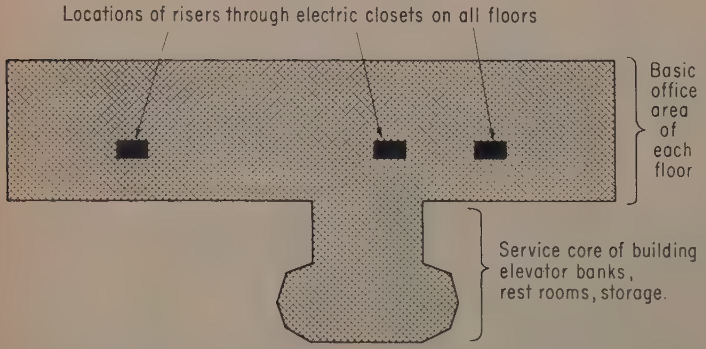
A total of nine risers supply lighting and receptacle circuits in all of the building's office space—floors 2 through 22. Each of these floors has three electric closets with each closet located at the approximate load center of one-third of the total floor area. Risers from the basement switchboard to the floor closets are made at these three points in the plan of the building. From the lighting switchboard in the basement, three feeders are run to each of the riser points where they turn up to feed the panels.

Skillful subdivision of the total load of closets among the feeders along each riser route provided a major economy effect in the distribution system. At each riser loca-

PHOTO G—OVERHEAD PULLBOX provides for change in direction of feeder runs from both the power switchboard (foreground) and the lighting switchboard (in back). Again all conduits were field bent to positions.


480/277-volt bus in utility vault
Service conductors: 6-750 MCM per phase and 6-500 MCM for neutral
CTs for metering
Emergency feeder tapped ahead of service main in lighting switchboard
3000-amp, electrically-operated power circuit breaker for main in each service
400-amp trip molded-case CBs
Molded-case CBs rated 250, 400 or 600 amps
600-amp spare CB
100-amp, F-frame CB
All feeder devices are combination units consisting of circuit breaker plus a set of current-limiting fuses.
Lighting switchboard
Power switchboard
Emergency system
120/208-volt panels for stairway and exit lighting on all floors
480/277-volt panel for emergency power

SINGLE-LINE ARRANGEMENT of service conductors, main CBs and feeders from both switchboards. Note the emergency lighting supply tapped from the line side of one of the power CBs. Both voltage levels are available for connection to essential power and light loads which can be kept operating when the lighting switchboard fails. Of course, this is actually only a limited provision of emergency power and would not cover loss of utility power.

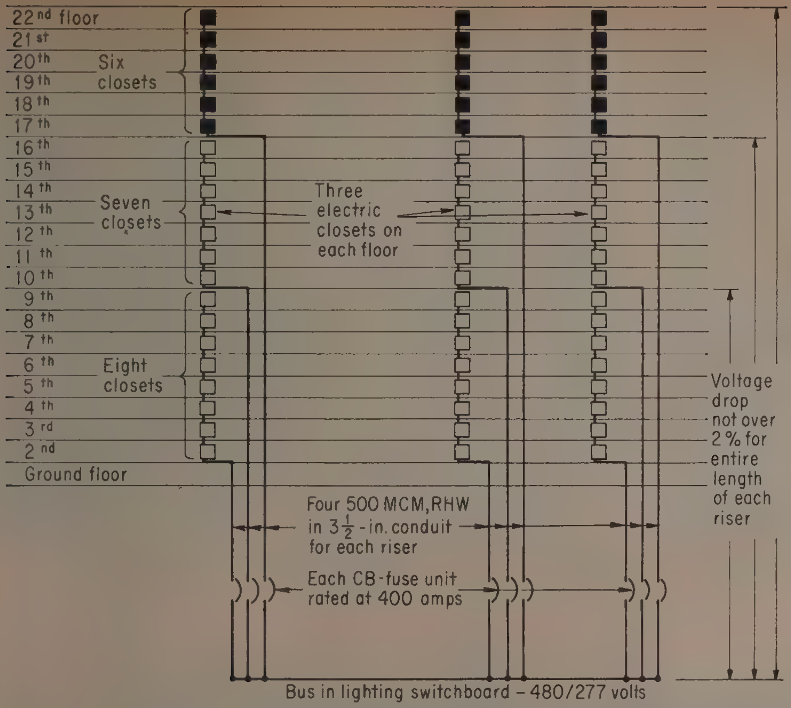

Locations of risers through electric closets on all floors
Basic office area of each floor
Service core of building elevator banks, rest rooms, storage.

PLAN VIEW of building throughout its height shows relationship of lighting risers to typical office space. Projecting segment of building houses all essential building facilities to keep the office area of all floors uniform and unobstructed. Spacing of electric closets provides for load-center branch circuiting with low voltage-drop and efficient use of circuit wire and conduit.

tion through the height of the building, one feeder supplies the bottom eight floors, the second feeder supplies seven floors in the middle of the building's height and the third feeder supplies the top six floors. With the design demand load the same for each of the electric closets, the feeder serving the bottom eight closets has a heavier load than the one serving the middle seven closets, which in turn is more heavily loaded than the feeder to the top six closets. In designing each feeder to deliver its kva capacity with only 2% drop in voltage from the switchboard to any panel, the unbalanced loading of the feeders made it possible to use a single makeup—four 500 MCM, RHW conductors in 3½-in. conduit—for each of the feeders. The one size of feeder can supply a total load of eight closets with a 2% voltage drop for the given distance from the switchboard to the load, but it can only supply a total of six closets with a 2% drop when the feeder has to run to the top of the building.

The use of a basic feeder makeup for all feeders provided two distinct advantages. First, four 500s in 3½-in. conduit is a highly economical and efficient makeup based on kva delivered, voltage drop and cable power loss—measured against installed cost of the feeder. Based on a given demand load on the feeder, other alternative makeups using multiple conductors—say, two 250 MCM per phase and neutral in 4-in. conduit or three 3/0 per phase and neutral in 4-in. conduit—might prove more efficient from a voltage drop standpoint for the current delivered but the overall installed cost would be higher. The second reason for selecting a single feeder makeup was to minimize construction costs. With the use of only 500s in 3½-in. conduit, the contractor would have the advantage of needing only one wire and conduit size for all of the lighting feeder work, permitting greater standardization and mechanization in installing the conduit, pulling the conductors, coupling to panel enclosures, making taps, installing lugs, etc.

In the initial design, sizing of feeders for the given loads was


22nd floor
21st
20th
19th
18th
17th
16th
15th
14th
13th
12th
11th
10th
9th
8th
7th
6th
5th
4th
3rd
2nd
Ground floor
Six closets
Seven closets
Eight closets
Three electric closets on each floor
Voltage drop not over 2% for entire length of each riser
Four 500 MCM, RHW in 3½-in. conduit for each riser
Each CB-fuse unit rated at 400 amps
Bus in lighting switchboard – 480/277 volts

BASIC RISER SCHEME for lighting and receptacle loads throughout the building affords one, efficient makeup for all of the feeders with the inherent construction economy of such an arrangement.

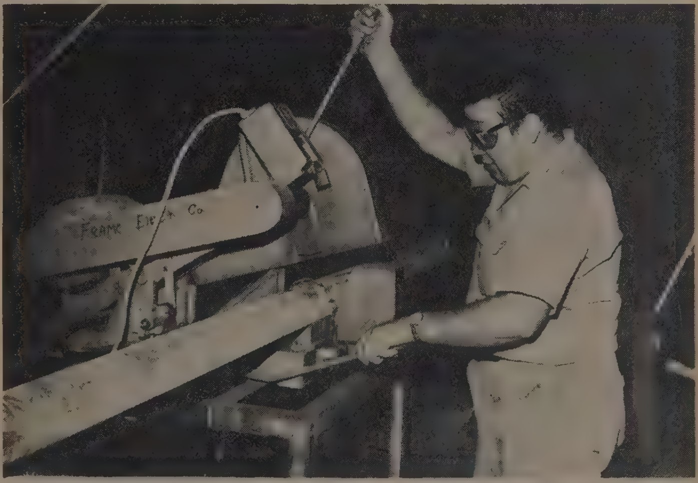
TYPICAL ELECTRIC CLOSET (under construction) contains 480/277-volt panel (right) with supply taps to panel made from riser conductors run through oversized gutter of panel enclosure. Bolted-type pressure taps are used with rigid, molded insulating jackets for the tap connectors. This panel supplies 277-volt circuits for general area fluorescent office lighting. One circuit in this panel feeds the 480-volt, 3-wire, 3-phase primary of the ceiling mounted 9-kva transformer which powers the 120/208-volt, 3-phase, 4-wire panel at left rear. This panel supplies receptacle circuits in the cellular metal floor system and some miscellaneous lighting in the service core. Other riser conduits to floors above are shown in rear center of photo. Compact layout of equipment minimizes floor space requirements leaving maximum rentable area.

based on the voltage drop characteristics of the circuits in steel conduit. For the original plan, available kva at each lighting panel conformed to anticipated initial and future demands of tenants. When, however, a decision was made to install the feeders in aluminum conduit, available tenant kva capacity had to be recalculated on the basis of lower reactance—and, consequently, voltage drop—of circuits in non-magnetic enclosures. As a result, it was found that load could be increased from 10-15% without exceeding conductor current rating or the required limit of 2% voltage drop in each feeder.

Each lighting feeder is carried through the enclosures of the panels it supplies, with taps for each panel made in the oversized gutter space. Lighting circuits operating at 480/277 volts, 3-phase, 4-wire are run in conduit to junction boxes laid out at intersections of a grid pattern of branch conduit runs in the space above the suspended ceiling of all office areas. This pattern of layout was used because actual layout of lighting fixtures in any office area would not be known until after the space was leased and the tenant selected his own lighting plan. Grid layout of boxes will accommodate any desired spacing of luminaires. Each such layout was installed with circuit homerun conductors in the conduit.

Each of the three electric closets

(Continued on page 146)



CUTTING ALUMINUM conduit was done quickly and cleanly with this rotating abrasive wheel. Conduit is placed in the cradle, lining up required cut mark on conduit with mark in cradle, and then strapped in place with the length of chain. Electrically-operated wheel is then brought down across conduit, using the top handle as shown. With relatively little pressure, the wheel cuts the conduit like it was slicing baloney. There is no flaring-in of the ends at the cut; and the cut is free of burrs, ready to ream and thread.

FORK LIFT unloads strapped bundles of 4-in. fiber conduit from flat bed truck; spots them along length of duct trench. Each bundle contains 85 10-ft conduits and weighs about 1,700 lbs.

TRUCK BOOM LOWERS duct bundles to concrete base of trench. Hook slings are easily attached and detached. Cartons of couplings are within easy reach.

Modern Methods Speed Underground Duct Work

Streamlined materials handling techniques accelerate installation of multi-tier banks of fiber conduits at O'Hare Field, Chicago's International Airport.

BULK handling of electrical equipment is pacing the installation of underground distribution at O'Hare Field, Chicago's 7,100-acre International Airport. This phase of construction is a vital part of a $120-million expansion of facilities to accommodate increased jet aircraft operations and passenger traffic.

A maze of underground ducts will provide power, lighting and communications to a complex of new and extended runways, taxiways, concourses jutting out like spokes in a wheel, and hangars and other buildings being constructed at the site. Underground circuits are provided with automatic transfer devices so that if one circuit fails, another takes over in a fraction of a second. Should primary power sources fail, emergency generator equipment at the site will start automatically within seconds and take over the electrical load to guide aircraft into and out of the field and keep the area operational.

The predominant underground raceway is 4-in. fiber conduit, impregnated with protective coal-tar pitch during manufacture and encased in a monolithic concrete envelope during installation. Multi-tier duct banks contain as many as 68 parallel conduits which enter and leave 3-cell concrete manholes at intersections and cable-pulling points in long runs. Present plans call for installation of some 2½ million ft of this duct to handle anticipated requirements and any future growth of the airport.

Speed generally is a byword of airport construction. And this applies equally to the electrical work. A number of factors permitted the electrical contractors to match, or exceed, construction progress. Among them were:

1. Availability of the fiber conduit in 10-ft lengths instead of the standard 8-ft sections. This meant that electricians handled 250 fewer pieces of duct for each 10,000 ft installed.

2. Delivery of duct in pallet-type bundles of 85 lengths (1,700 lbs) on flat-bed trailer trucks for simplified fork-lift unloading.

EXTRACTING DUCT from loosened bundle is a simple chore. The 20-lb lengths are carried a few feet to duct bank. Bundles were spotted to speed installation and reduce backtracking to absolute minimum.

DUCT BANKS are built up section by section. Here second layer of 4-tier bank is being nestled on spacers and coupled. Note couplings within arm's reach of mechanic. Each tier has 17 conduits.

STEEL BANDS are clamped around duct bank at spacer locations. Strapping provides rigid structural unit; keeps individual ducts from shifting or floating during concrete pour.

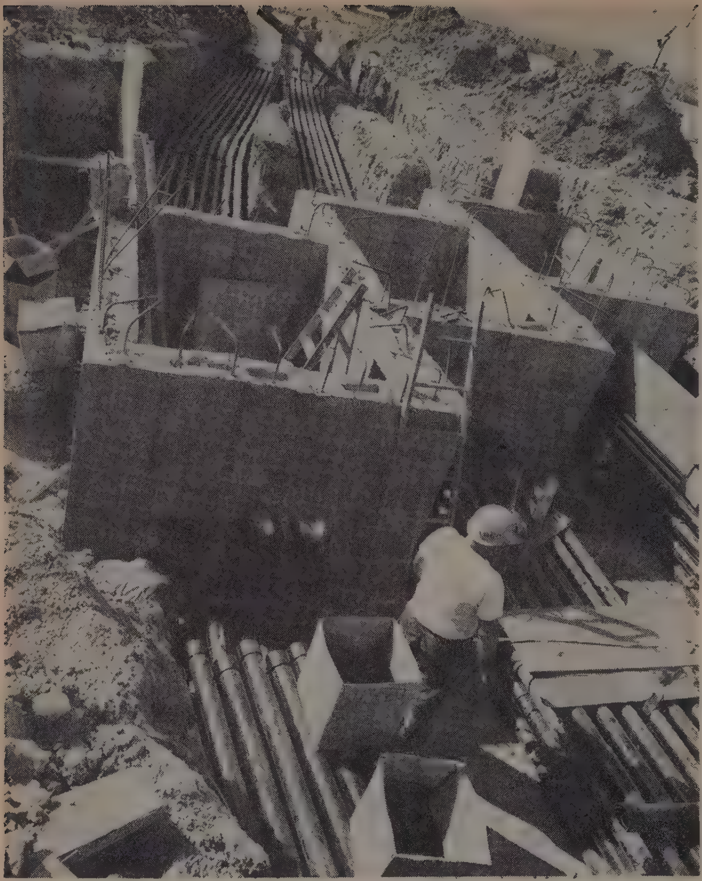
CONCRETE IS POURED on top of duct assembly. Flexible-shaft vibrator forces mixture around fiber conduits in 4-tier bank to produce a protective monolithic envelope.

3. Extensive use of fork lift and boom trucks for unloading, dispersing and lowering of duct into trenches.

4. Coordinated delivery of transit-mix concrete to pour the protective duct envelope.

The first segment of underground duct work at O'Hare was done by Main Electric Co., Chicago. Its organized field operations, illus-

CONDUITS FAN OUT in groups of 12, 24, and 32 ducts to enter and leave a 3-cell manhole at cable-pulling and maintenance point in long underground run.



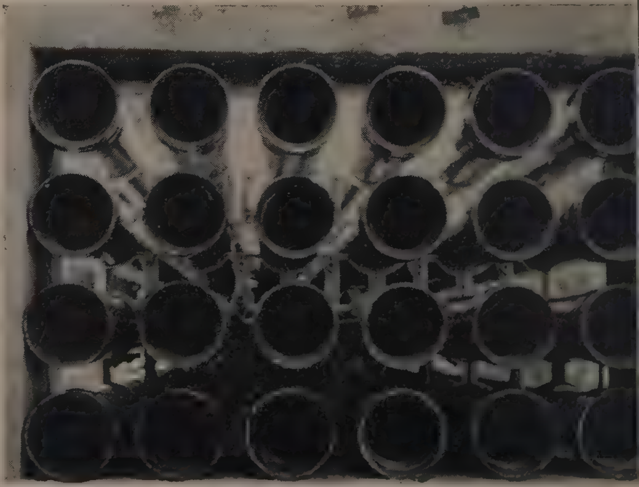
OFFSET DESIGN of 3-cell manhole construction for underground power, lighting and communication circuits.

trated by the accompanying sequence photos, typify the electrical contractors approach to work of this type. The ultimate goal is efficient use of men and machines to do a better job in less time. Loaded trailers were delivered to the installation site. Fork-lift trucks unloaded the duct bundles and spotted them along the top of the open trenches. A boom truck lowered the bundles to the concrete pad at the bottom of the trench. Predetermined locations were selected to minimize walking distance between conduit bundles and the point of assembly by mechanics working in the trench.

Fiber conduits were withdrawn from the loosened bundles and installed on interlocking spacers to form the specified duct-bank configuration. Where duct groups fanned out to enter the 3-cell manholes, factory-made offset-couplings and short duct sections, cut and reamed in the field, were used to maintain flush entrance. Once the duct was tiered, mechanics bound the assembly with steel strap using the conventional strap tensioning and clamping tool. This precaution assured structural rigidity and maintenance of duct alignment and spacing when concrete was poured from transit-mix trucks to form the protective envelope. After final curing, bulldozers backfilled the duct trenches.

Naess & Murphy, Chicago architectural and engineering firm, is masterminding the entire expansion program. Their project manager, Carter Manny, Jr., directs front office planning as well as site work at O'Hare. All construction work is under the supervision of Walter Metschke and Harry Kagamaster of Naess & Murphy. Six electrical engineers under Kagamaster's direction coordinated the electrical system design and installation.

MECHANICS TAILOR conduit runs for flush entrance into manholes; use angle couplings and short duct lengths cut, tapered and reamed at the site for dogleg offsets.



DUCT ALIGNMENT and separation maintained by spacers is shown by this view of a 24-duct group from inside a manhole. Concrete envelope has not yet been poured outside.

• ESTIMATING FORUM—VI

The Standard Labor Unit

By **Ray Ashley**, *Research and Consulting Engineer, Oak Park, Ill.*

QUESTION: *What is a standard labor unit?*

ANSWER: *A labor unit adopted by the individual estimator as a standard for his personal use.*

DISCUSSION:

The above definition immediately prompts two pertinent questions:

1. How can several estimators use the same table of units if each has his individual standards?
2. How can values in tables used by good estimators vary so much?

Using Same Tables—Two estimators may use the same tables of labor units. However, each assigns his individual meaning to such units.

For example, consider outlet box units. The unit supplied by the table may be 0.50 hours each. Estimator "A" will take it to represent the layout and installation time only. Estimator "B" will use it for the complete installation including all incidental labor and supervision.

When figuring a particular project, "A" will reduce the standard unit to 0.45 hours each and add separate labor items for pipe entrances, incidental labor and supervision. Assume his estimate is correct and, with all items added, he has a total of 0.60 hours chargeable to the outlet.

Estimator "B," on the other hand, includes all incidental labor and supervision in his units. He will have to adjust the standard 0.50 unit upwards to 0.60 hours.

So we have estimator "A" and "B" using the same table of labor units but adjusting them according to his own interpretation of their meaning. The units are "standard" as to listing but "individual" as to interpretation.

Individual Tables Vary—Tables of rigid conduit labor units representing the standards of estimators "A," "B," and "C" are shown in Fig. 1. While these examples are somewhat radical, they serve to

(Continued on page 148)

LABOR UNITS USED BY ESTIMATORS A, B, AND C*

Rigid Conduit—Hours Per 100 Ft.

CONDUIT SIZE	Est. A. (Low)	Est. B. (Medium)	Est. C. (High)
½ in.	4.00	5.00	6.00
¾ in.	4.50	6.00	7.50
1 in.	6.00	8.00	10.00
1¼ in.	7.50	10.00	12.50
1½ in.	9.00	12.00	15.00
2 in.	12.00	16.00	20.00
2½ in.	16.50	22.00	27.50
3 in.	21.00	28.00	35.00

* Stipulations limiting use of units such as ceiling height, construction, hangers etc., not given.

FIG. 1. Labor units of individual estimators may be high or low. But they represent just so many figures unless one knows all details such as construction type, ceiling heights, project type, etc.

INDIVIDUAL LABOR UNIT ADJUSTMENT TO MATCH JOB CONDITIONS

JOB NO. 1	JOB NO. 2	JOB NO. 3
(25% Above Normal)	(Normal)	(25% Below Normal)
A. +66⅔%	A. +33⅓%	A. No Change
B. +25%	B. No Change	B. —25%
C. No Change	C. —20%	C. —40%

Note: A. B.C.—Estimators whose labor units are shown in Fig. 1.

FIG. 2. Adjustments of the individual's labor units are made to take into account anticipated job conditions. Table shows percentage change in units of three estimators for job costs that are above normal, and below normal.

Electrical Features Are Hotel Plus Values

DOWNLIGHTED MARQUEE supports hotel's luminous free-standing name-sign; extends over driveway leading to mercury-vapor-lighted parking area; welcomes guests to modern lobby and public areas in Portland's newest showplace.

New $6-million hotel in Portland, Ore., attracts guests with imaginative lighting, visual message annunciators, direct-dialing telephones, restaurants served from 800-amp all-electric kitchen center. Behind-the-scenes service is promoted through modern telautograph and intercom systems, convenient motor control centers and busduct riser.

By **James Connor,** *Job Supervisor, Wismer & Becker; Electrical Contractors, Sacramento, Calif.*

A $6-MILLION hotel, modern in every respect and adhering to quality standards in service, construction and electrical design, has been opened in Portland, Ore., to become the newest link in the Sheraton chain.

Lighting of public areas reflects imaginative use of components and fixtures. Several dining areas are served from all-electric kitchens. Motorized equipment is flexibly controlled from local stations as well as from motor-control centers. Air conditioning provides climatic comfort in all areas of the building. Guest rooms are attractively illuminated and provided with numerous duplex receptacles, TV outlets and visual message annunciators. Self-service elevators are fast and silent, and quality service is furthered through the media of telautograph and intercom systems that connect key executive and service centers.

Illustrative of imaginative lighting:

. . . A terraced, circular dining room has a lighting plan combining a central chandelier and illuminated cove with series of luminous Plexiglas domes, cold cathode installations above colorful (fireproofed) light-diffusing awnings, plus recessed downlights of several designs placed above tables and aisles. Also, since the room overlooks an attractive outdoor swimming pool and sunken garden, diners likewise can enjoy a variety of underwater and outdoor lighting treatments.

. . . Another restaurant, designed in a Kon Tiki motif saluting the state of Hawaii, utilizes numerous stage-lighting and show-window techniques in conjunction with motorized dimmers, ultraviolet and colored lamps to simulate tropical sunsets and storms and to highlight intriguing displays of rock formations, waterfalls, tropical plants and flowers.

. . . A novel cocktail lounge, dedicated to our second new state, Alaska, likewise utilizes banks of packaged dimmers, transformers and relays to control 29 separate cold-cathode cove installations located around the lounge periphery and above series of bearskin-covered discs having varying diameters and suspension elevations.

. . . The main ballroom, generally illuminated by recessed downlights and linear beamslots placed between air diffusion vents, is also equipped with banks of runway spotlights, rotating lenses and ceiling plates for use in connection with fashion shows and similar events. In addition, a flexibly lighted stage (borderlights, curtain accent lights, tormenters, fresnel spots and stage pockets) can be controlled from

COMPACT 3-GANG switching and signaling center in foyer of typical guestroom contains two 120-v pressure buttons related to control of lighting, also central 24-v bullseye annunciator that informs occupant of messages or mail being held for him at lobby desk. Annunciator is activated by . . .

TOGGLE SWITCH at top-inside of mail-and-key slot, flipped on by desk clerk upon insertion of messages; switched off when messages are withdrawn. Low-voltage signal system involves extensive 24-v riser installation; is segregated from 120-v lighting circuits in common 3-gang guestroom box by metal barriers and nipples.

either a wing-located panel or from a projection booth where 15 5-kw autotransformers, ten 4-kw and ten 2-kw thyratron dimmer units may be regulated from a pre-set scene-lighting console.

. . . Even in upper hallways of typical guest-room floors, imagination is reflected by placement of lensed fluorescent troffers and incandescent downlights, since successive linear and circular units are staggered from side to side in order to detract from the usual "tunnel effect" of uninterrupted lines of light in long corridors.

. . . Outside of the hotel, in addition to garden and pool lighting already mentioned, guests are favorably impressed with a downlighted marquee supporting the hotel's free-standing trans-illuminated name sign; a sign which is duplicated also on a larger scale and in color on the roof of the building. Parking areas are also well lighted with conventional pole-mounted arm-supported mercury-vapor luminaires, while walkways and landscaped borders are edged with attractive "mushroom" units.

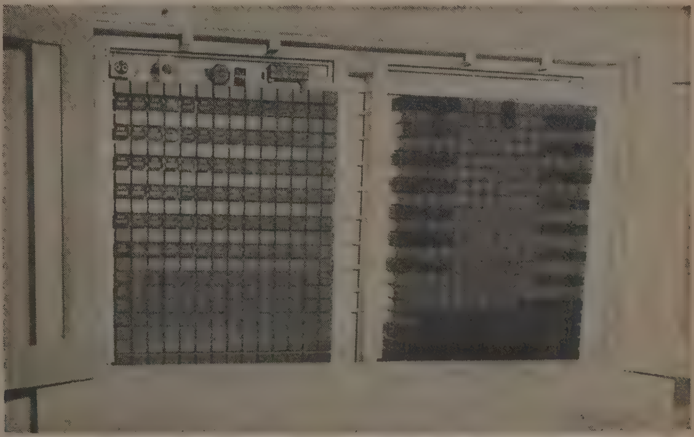
To achieve these and many other lighting treatments, more than 70 fixture types and variations were specified, such fixtures ranging from louvered and lensed troffers to special ornamental suspended luminaires, weatherproof and vaporproof units, adjustable spot and floodlights, translucent and edge-lighted signs.

Electric Kitchens

Since separate kitchens for the various services (terrace dining room, oriental Kon Tiki restaurant, banquets, room service and cold pantry) are grouped together at one centralized location, and since all kitchens are electric, it is not surprising that four power panels are required to control such 480-volt equipments as ranges and ovens, broilers and fryers, dishwashing and food-disposal equipment, water heaters and the like, plus such 120/208-volt equipments as refrigerators and toasters, slicers and mixers, blowers and coffee makers, infrared reheating shelves and so on. Connected loading in this centralized kitchen area amounts to 450 kw at 480 volts plus 90 kw at the lower level; a combined demand in the order of 800 amps.

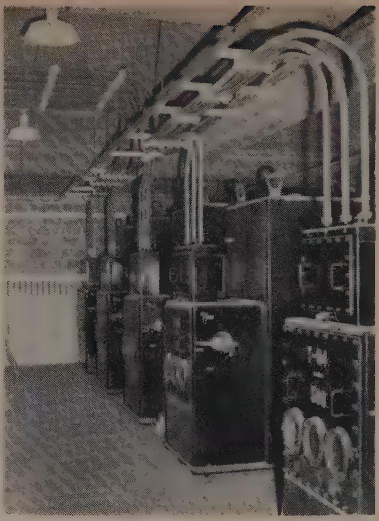
Public service areas are also pro-

PLUG-IN BUSDUCT carries 120/208-v power to upper-floor service rooms, take-offs for local control panels being made through 200-amp 4-pole full-neutral disconnect switches. Service rooms also contain telephone risers and cabinets, watchman key stations, equipment, fire alarm bells and signal panels.

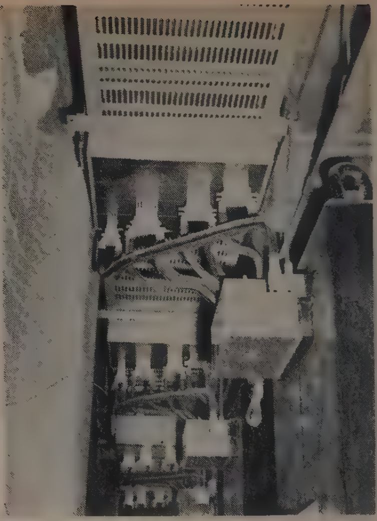


DIRECT DIALING from guestroom telephones is automatically recorded on panels located adjacent to cashier desk. By bypassing switchboard, telephone service is improved. And, by providing cashiers with accurate up-to-the-minute toll-charge information, check-out time is reduced.

TUNNEL EFFECT in guest-floor corridors is minimized by staggering linear fluorescent lensed troffers and circular incandescent downlights from side to side of hallways as indicated by lighting pattern observed in background. Elevators, mail chutes and stairwell doors are identified by edge-lighted signs, while these areas are illuminated by higher intensities.



PRIMARY SERVICE at 11 kv is stepped to 480/277 volts by three 750-kva transformers, and to 120/208 volts by two 500-kva units. In addition, operation of emergency lighting, motors and sprinkler equipment is doubly insured through provision of a sixth 50-kva transformer and automatic transfer switch which operates if normal power fails.



SECONDARIES OF 11-kv/480/277-v transformers are connected to 4-wire half-neutral ventilated 4000-amp current-limiting busduct feeder via flexible cable leads. Busduct, suspended as here shown from vault ceiling behind transformer bank, pierces wall, then drops to main breaker of 480/277-v switchgear located on lower basement level.

vided with such audio-visual equipment as strategically placed speakers for the transcription of music obtained from turntable, tape AM or FM radio; while function and ballroom areas are additionally equipped with TV camera floor pockets and outlets for TV projectors with screen projection ranges of 60 ft.

Cone speakers, recessed in wall baffles behind grills blending with existing decorative decors, are sufficient in number, spaced close enough together and so oriented that uniform dissemination of sound is obtained at modulated volume while dead spots, hot spots, feedback, echo effects and cone vibrations are completely absent. Local volume and switching control is possible from any area and, when it is desired to use this sound system for dissemination of programs originating in the ballroom or function rooms, any combination of 20 microphone locations can be linked to the system through a sound cabinet (located in the projection booth) containing all necessary pre-amp and power amplifiers, tone and zone control switches.

When TV projectors or cameras are in use, they may be connected (through floor-pocket circuitry) either to a riser system extending to a roof-based antenna, a closed-circuit telephone terminal, or to an exterior mobile video control truck for network televising. Floor pockets used for this purpose have conduit and cable-rack facilities related to antenna, mike and power circuits, also top and bottom removable covers that permit access from the main floor above or from the basement below. The TV antenna on the roof, in addition to serving floor pockets and an RCA monotran unit on the main floor, also serves over 300 outlets in guest rooms, public and service areas through a roof-to-basement sequence of five junction boxes and 31 risers—each such riser tapped to serve between eight and ten separate TV plug-in coaxial outlets.

With telautograph message-initiating equipment located at the central switchboard, mail desk, bell captain's station and engineer's office, it is possible to transcribe written messages between any of these important points or to local guest-floor service rooms to record instructions for maids, linen matrons or watchmen. And, should guests wish to make outside local or long distance phone calls, direct dialing from all rooms speeds service by by-passing the central switchboard, although operators and room-service departments can be contacted by local dialing when desired. In connection with direct dialing, it is interesting to add that such calls are automatically recorded and totalized on a monitor panel at the cashier's desk, thereby speeding "checkout" time by eliminating the necessity of cashiers having to first check with the telephone desk to ascertain whether any recent calls have been omitted from guests' billing sheets.

Notification of mail and message receipt is likewise speeded through the medium of 24-volt bullseye annunciators located in guest-room foyers. These visual indicating lights are mounted, together with two 120-volt pressure switches related to lighting, in a compact attractive 3-gang assembly. Barrier places in backing boxes segregate high- and low-voltage wiring, 120-volt circuits being carried laterally to local floor distribution panels; while 24-volt risers drop through the building vertically to link rooms with the main desk. Individual annunciator lights are controlled by toggle switches mounted beneath corresponding message slots at the lobby location. Such switches are manually triggered by the clerk inserting or withdrawing letters or messages.

Lighting, power and electric heating equipment in the building is served through two main distribution centers, 480/277-volt being provided for air conditioning compressors and fans, electric water heaters, ranges and ovens, steam generators, pumps and some fluorescent lighting in service areas. Other 120/208-volt circuitry serves small motors plus power, lighting and some heating units located on typical guest-room floors.

Local distribution panels on such floors are served through a vertical 1000-amp busduct rising through the building from the basement, connections of panels to this riser involving 4-pole full-neutral 200-amp disconnects having lesser-amperage tripping characteristics, depending upon connected loading on various floors.

This busduct riser is one of three similar-capacity 120/208-volt runs, the other two serving main distribution boards located in the basement and on the first floor. All three are served through fused reducers from a 3000-amp low-impedance busduct connecting the bus-intersection point with the main 120/208-volt switchgear.

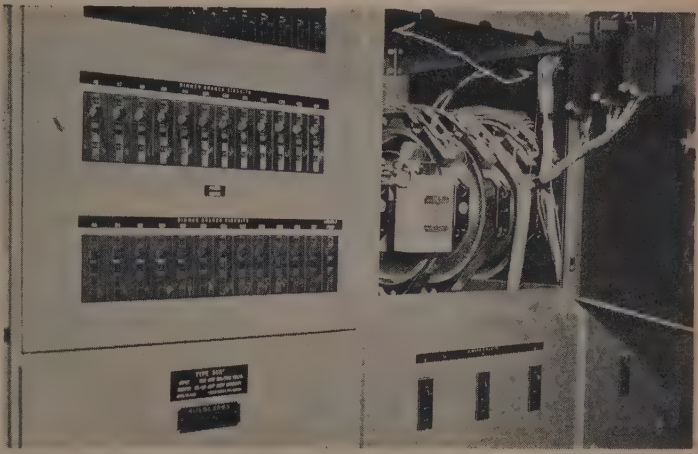
Completing the 120/208-volt distribution sequence to its source, a 4000-amp full-neutral current-limiting busduct service main connects the main switchgear with secondaries of two 500-kva transformers, primary service being delivered via underground ducts to a basement vault at 11 kv.

In addition to these two normal-service transformers, a 50-kva emergency network transformer is provided to insure essential lighting for stairwells, corridors, assembly halls and the like. A 3-pole 4-wire 150-amp automatic switch transfers this load from normal-service to emergency feeders in event of an interruption of the preferred power source. This emergency transformer likewise serves a sprinkler alarm control panel through a separate feeder and 2-pole single-phase industrial switch.

In the 480/277-volt distribution sequence, three 750-kva transformers are connected to a related switchboard through a ventilated 4000-amp 3-phase 4-wire half-neutral current-limiting busduct, cables in conduit then extending from feeder breakers either to major motors directly or to motor-control centers.

Designed by architects Perry, Shaw, Hepburn & Dean, and engineered by consultants Stressenger, Adams, Maguire & Reidy, all of Boston, the electrical system was installed by contractors Wismer & Becker of Sacramento, Calif.

PRIMARY SWITCHGEAR includes 11-kv incoming line cubicles that flank automatic transfer switch, also feeder breakers related to transformers, metering and PT equipment in free-standing metal-enclosed grounded assembly.



AUTOTRANSFORMER DIMMER equipment for control of 46 lighting circuits in ballroom and assembly rooms consists of 15 5-kw transformers operated by seven motorized regulating units. Lighting load in ballroom totals 50 kw.

STAGE LIGHTING and runway spotlights are controlled through 20 thyratron dimming units and master control console that permits smooth transition between successive pre-set lighting effects involving border lights and stage pockets, fresnel spots and curtain accent illumination. Sound cabinet at left combines controls for 20-microphone and 30-speaker stations, tone and zone controls, voice pre-amp and power amplification, also input jacks related to tape, record turntable, AM and FM radio broadcasts.

Infrared Spot Heating

A simple method of determining heating capacity required for controlled radiant heating of small areas.

By Lowell R. Mast, *Electromode, Div. of Commercial Controls Corp., Rochester, N. Y.*

ELECTRIC infrared heating of personnel is the ideal solution to problems arising from cold or drafty spots in heated areas, unheated locations, or outdoors. Since heating is local and is accomplished by direct radiation, detailed heat-loss calculations are neither feasible nor necessary. The principal consideration is the overall comfort of the person receiving the radiation, as determined by (1) the capacity of the heater or heaters, (2) their mounting height, (3) the outdoor temperature, and (4) the nature of the area or space to be heated. The simple procedure detailed herein has been used in many existing installations and has been found to produce conditions of comfort.

Heaters may be wired permanently or provided with a portable cord for dismounting during the non-heating season. Portable use makes double duty possible. For example, heaters may be used over a patio in early spring and late fall and then moved to an unheated garage for occasional use during the winter months.

The following examples, plus the accompanying photographs, will serve to illustrate the variety of possible applications of infrared radiant heat and the method of determining heater capacities.

The Electric Heating Forum is designed to provide a means of industry-wide communication on electric heating practices and problems.

This month the principles and installation of infrared heating equipment for industrial, commercial or residential areas are discussed; an extensive sidewalk cable heating job is presented with complete design details; and Ebasco Services, Inc., provides conclusions on the space heating outlook for the next year based on a recent industry survey.

Readers are invited to express their opinions; relate their own experience data to the material presented; or submit new ideas, research data, or case studies on any aspect of electric heating. Please address correspondence to:

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Electrical Construction and Maintenance
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OUTDOOR PATIOS may be used early in the spring and on into the fall when provided with infrared heat. This installation incorporates two 4000-watt heaters mounted on the building and directed at the patio seating area.

INFRARED RADIATION

So-called "spot" heaters or infrared heaters perform a needed function in the space heating picture because of the type of radiation involved.

Infrared radiation is of the same nature as visible light and ultraviolet rays. It occupies that portion of the electromagnetic spectrum between visible light and radio waves; hence it has a longer wavelength than visible light. It is characterized by its heating effect on bodies or opaque objects.

The infrared portion of the spectrum (from about 0.8 to 310 microns) may be broken down into three divisions: near, intermediate, and far infrared.

Near infrared radiation is closest to visible light and is emitted by incandescent tungsten or carbon filaments in an evacuated heat-resistant glass enclosure. In such sources much of the energy supplied is transformed to visible light; some is lost as a result of conduction and convection; the remainder is available for heating by direct radiation. However, although intervening air is penetrated with little absorption, solids absorb this type of radiation in varying degrees depending upon their color, surface texture, and nature of material. Near infrared is usually unsuitable for building heating purposes because of the strong visible light emitted. Where the presence of the light is not objectionable, such as at mounting heights of 25 ft or more, near infrared may be put to good use because of its penetrating characteristics.

At the other extreme, producing little or no visible light, is the far infrared radiation characteristic of low-temperature heat sources such as metals, glass, and open coils. Such heaters are suitable for space heating applications where conduction and convection effects are desirable or can be tolerated. Percentage of conduction, convection, and direct radiation varies with emitter material and heater configuration. Due principally to the significant convection involved, buildings must be well insulated and of moderate ceiling height to avoid considerable loss of heat.

For spot heating installations such as are described in this article, the intermediate infrared heater is most efficient. Its radiation is absorbed by all colors and surfaces to a greater extent than near infrared, and there is practically no absorption of heat by the intervening air. In a cold environment, indoors or outdoors, the heating effect is pronounced within a few minutes after the heater is turned on. Fused quartz tubing used as the emitter in such heaters is the most efficient known transmitter of infrared rays.

Example 1:

Enclosed porch 12 × 25 ft; outside design temperature 15F; practical mounting height 13 ft.

Required density from Table 1: 22 watts/sq ft
Add .10×4 ft×22 for height : 8.8 watts/sq ft

Sub total: 30.8 watts/sq ft
From Table 2, subtract 2.25 for 15F ....: 2.25

Total density required : 28.55 watts/sq ft
Total watts required = 28.55 × 300 sq ft = 8565 watts.

Economics usually dictate the use of the fewest number of heaters which will supply the required wattage and yet cover the given area adequately. Assuming ratings available are 1, 1.5, 2, 3 and 4 kw, the available possibilities for this application are three 3-kw, six 1½-kw, or nine 1-kw units. From Table 3, it is evident that three 3-kw heaters mounted in either of the two positions shown in the sketch on the following page will cover the 12 × 25-ft area with an overlapping heat pattern.

Example 2:

Outdoor covered patio 10 × 30 ft; outdoor design temperature 0 deg F; mounting height 8 ft.

From Table 1, an outdoor area partly sheltered requires 24 watts per sq ft. Since one side of patio fronts on the building, it is practical to install the units along the periphery of the patio roof, radiating at an angle into the area. The mounting height may then be considered to be approximately 9 ft, as shown in the sketch. Since no correction is needed for height or outdoor temperature, the total watts required will be 24 × 300 sq ft or 7200 watts.

To insure even distribution over the entire area at 9-ft mounting height, a check of Table 3 indicates that five 1.5-kw heaters arranged as shown in the sketch would be satisfactory. However, two end units rated 2 kw each plus a single 4-kw unit at the center of the 30-ft side would also provide adequate coverage of the area. Location of units will depend in general upon patio configuration and seating arrangement.

BANK DEPOSIT WINDOW area is kept comfortably heated for teller and depositor by a single 1500-watt infrared unit mounted vertically above window. Pens, paper, and counter are kept at comfortable temperature while business is being transacted.

Procedure for Determining Heater Capacity

1. Measure the area (sq ft) of the space occupied by the personnel to be heated.
2. From Table 1, select the basic heat density (watts/sq ft) which applies to the type of space involved.
3. Find a heater location which will provide direct radiation to the personnel to be heated. Heaters mounted on or suspended from the ceiling 9 ft above the floor directly above the personnel will give the most satisfactory results. Where it is necessary to use lower or higher mounting heights, the basic density value of Table 1 should be modified as follows:

   Add 10% for each foot above 9 ft.
   Subtract 10% for each foot below 9 ft.

   For very high or very low ceilings, the heaters can be mounted on the side walls radiating at an angle into the area. In some cases it may be desirable to mount them at or near floor level radiating upward. Where angle radiation is employed, use the distance measured along the axis of radiation rather than the mounting height.
4. The basic heat densities of Table 1 are applicable for an outside design temperature* of 0 degrees F. For other design temperatures, the heat densities of Table 1 must be either increased or decreased in accordance with Table 2.
5. After obtaining the total watts required, the final step is to determine the number of heaters required and the capacity of each. Table 3 gives representative floor area coverage for two groups of heaters: 1000, 1500 or 2000 watts, and 3000 or 4000 watts. Since coverage varies with length of heater and type of reflector at a given mounting height, these values may vary with the manufacturer. The second figure given in each case in Table 3 is the dimension parallel to the length of the fixture.

Table 1. Basic Heat Densities

Type of area to be heated	Watts per sq ft
Insulated building	10
Uninsulated building	16
Shell-type (Quonset)	19
Glass porch	22
Outdoors, partly sheltered	24
Outdoors, no shelter	27

Table 2. Correction for Outside Design Temperature

Outside design temperature (°F)	Watts/sq ft to be added	Outside design temperature (°F)	Watts/sq ft to be subtracted
−30	4½	+30	4½
−25	3¾	+25	3¾
−20	3	+20	3
−15	2¼	+15	2¼
−10	1½	+10	1½
− 5	¾	+ 5	¾
0	0	0	0

Table 3. Heater Coverage*

Height of fixture from floor (ft)	Heaters rated 1000, 1500, or 2000 watts		Heaters rated 3000 or 4000 watts	
	Floor area dimensions (ft)**	Floor area (sq ft)	Floor area dimensions (ft)**	Floor area (sq ft)
9	10 x 13	130	10 x 13	150
10	11 x 14	154	11 x 16	176
12	13 x 16	208	13 x 18	234
13	14 x 17	238	14 x 19	266
15	16 x 19	304	16 x 21	336
17	18 x 21	378	18 x 23	414

* Heaters assumed suspended horizontally.
** Second figure is the dimension parallel to the length of the fixture.

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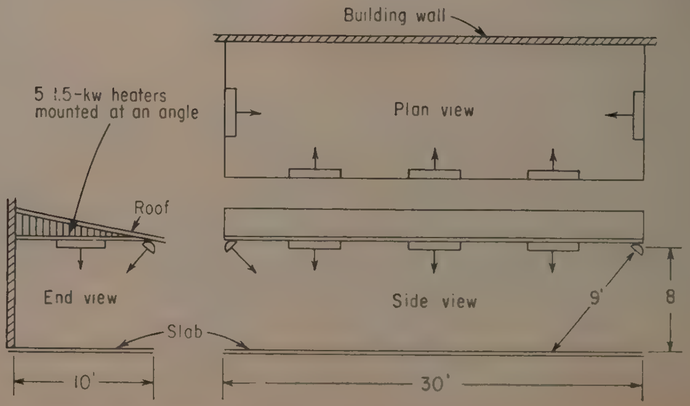
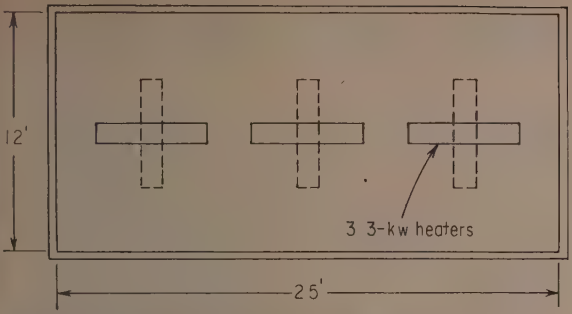
* See table of Climatic Data—U.S. Cities in "A Manual of Electric Space Heating, 1960" in *Electrical Construction and Maintenance*, March, 1960.

EXAMPLE 1: Enclosed Porch



EXAMPLE 2: Covered Patio



SPEAKER'S PLATFORM is heated by temporary units mounted at back wall beneath roof. Additional units mounted at floor level behind draped front railing radiate upward toward speaker and guests.

REPAIRS to outdoor equipment during cold weather may be facilitated by the use of an infrared heater mounted on a portable stand. Pictured is a 2000-watt unit on an adjustable mount to permit directing the radiation to the specific working area.

TRUCK LOADING AREA in manufacturing building is kept at a comfortable temperature during loading operations by a single 4000-watt infrared heater mounted at an angle inside the entrance. Direct radiation is concentrated inside the building; spill increases truck interior temperature.

Insulation Slide Film

Eliminating the Guesswork; 25 minutes; full color; $20.00. National Mineral Wool Assn., 1270 Sixth Ave., New York 20, N. Y.

Installed performance standards for thermal insulation in houses to be heated electrically are presented as a guide for contractors, heating equipment manufacturers, and utility personnel. The film explains in layman's terms how to figure insulation using the new "R" numbers to conform with the All-Weather Comfort Standard, followed by a graphic, authoritative demonstration of proper methods of installing batts and blankets.

Insulation Literature

How to Insulate Your Home for Electric Heating; 2nd edition; 33 pages. Single copies free; quantity prices on request. National Mineral Wool Assn., 1270 Sixth Ave., New York 20, N. Y.

A revised and enlarged edition including a new section on "R" values for specifying how much insulation is needed, together with precalculated "R" values that will meet the electric industry's All-Weather Comfort Standard for electrically heated and air-conditioned homes. Instructions for installing batts, blankets, and blowing wool have been expanded; sections are included on proper ventilation and available types of electric house-heating equipment.

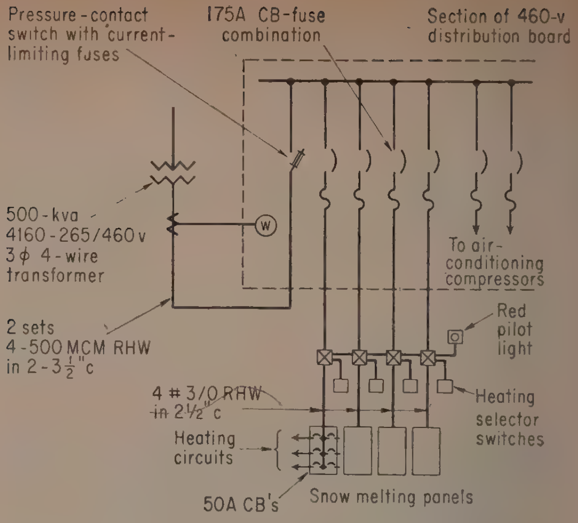
Planning Insulation for Electrically Heated Homes; 20 pages. Single copies free. Wood Conversion Company, First National Bank Building, St. Paul 1, Minn.

A comprehensive discussion of factors affecting proper performance of insulation, including thermal ratings, available products, moisture control, vapor barriers, window and infiltration heat loss, plus sample heat loss and heating cost calculations with reference tables.

Sidewalk Snow Melting

Heating cable keeps 13,600 sq ft of shopping center sidewalk clear of snow.

By Aubrey G. Caplan, E.E.


Pressure-contact switch with current-limiting fuses
175A CB-fuse combination
Section of 460-v distribution board
500-kva 4160-265/460v 3φ 4-wire transformer
W
To air-conditioning compressors
Red pilot light
2 sets 4-500 MCM RHW in 2-3½"c
4 # 3/0 RHW in 2½" c
Heating selector switches
Heating circuits
50A CB's
Snow melting panels

SINGLE-LINE WIRING DIAGRAM

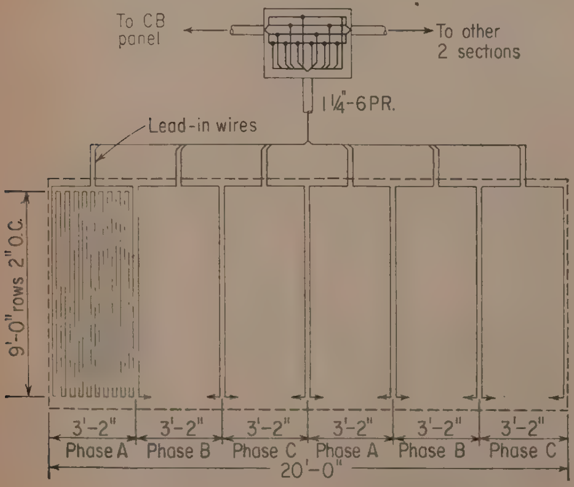
ELECTRIC heating cable embedded in the 10-ft-wide concrete sidewalk completely encircling the Joseph Horne Co. Department Store in the East Hills Shopping Center, Wilkinsburg, Pa., has done an effective job of melting fallen snow during its first winter of operation.

Installed last winter during a record snowfall, the system melted a 2-ft accumulation in four hours. It was subsequently found that it would keep pace with the downfall and keep the sidewalks clear if it were energized when the snow began to fall.

The system is designed to supply approximately 30 watts/sq ft. Sidewalk sections for the most part measure 20 by 10 ft, with exceptions at the corners and at building entrances. Each section uses six 190-ft lengths of Neoprene-covered nichrome heating cable, connected two per phase to a 3-phase, 4-wire, 460Y/265-volt No. 6 home run as shown in the accompanying diagram.

This gives 5 watts per lineal foot, or 5700 watts for each 200 sq ft. For 71 sections of sidewalk, the total connected load is 434.7 kw, or 550 amps.

Heating cable was attached to 2 × 2-in. wire mesh by means of tape, the mesh being shop-fabricated and delivered to the site ready for installation. Direct-burial non-heating leads from each cable assembly pass through 1¼-in. conduit to interior junction boxes mounted on the wall or in the floor. Floor boxes were used where window areas or doorways made wall space unavailable.



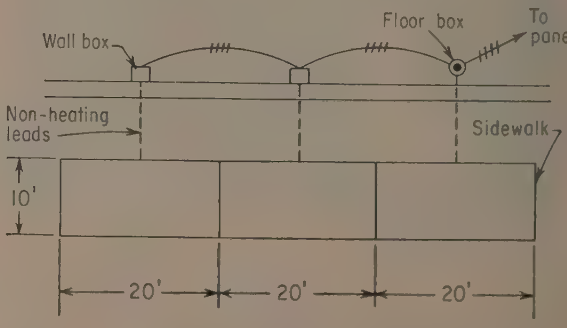
TYPICAL SECTION OF SIDEWALK

After the initial concrete pour, wire sections were laid in place and covered with the final 2-in. pour of green-dyed concrete. All sections were "megged" before, during and after the pour to insure continuity.

In general, each heating panelboard affords 50-amp circuit-breaker protection for six 3-phase circuits, each circuit feeding three sidewalk sections. Four panels, wall-mounted near each of the building's four entrances, are fed by 3-phase, 4-wire, No. 3/0 feeders protected at the main distribution board by 3-pole, 175-amp breaker-fuse combinations. Each feeder is interrupted by a mechanically held switch-controlled contactor. A red pilot light indicates when the system is in operation.

The 500-kva utility transformer serving the heating system also feeds the store's two air-conditioning compressors (360 and 60 hp); therefore, the same service used winter and summer through the same switchboard avoids duplication of transformers, service and panels.

System was designed by A. G. Caplan with the help of Woessner McKnight Co., E. L. Wiegand representative. Installation was made by electrical contractor E. C. Ernst, of Pittsburgh.



TYPICAL PANEL CIRCUIT

Electric Space Heating: Outlook for 1961

A summary of a report prepared by the Marketing Services Dept., Ebasco Services Inc., New York

THE residential electric heating market is expanding rapidly in all areas of the country. Activity is widespread, and custom and tract builders are beginning to accept electric heating as practical and salable. Manufacturers are looking to doubling sales next year, greatly encouraged by growing acceptance in the North and by special promotional heating rates being offered by utilities.

"Still in the future" characterizes the residential heat pump situation. This does not mean that applications are not growing and sales expanding. But it does mean that the heat pump—to supply all the heating required, efficiently and without supplementary heating at a competitive price—is still not here. One manufacturer reports that heat pumps in residential markets are the result of market "sophistication" rather than logic. However, this equipment can make a significant contribution to better living anywhere.

By contrast, commercial and industrial heat pump markets are booming. The equipment can be applied in two ways: in multiple installations—one or two to a floor—or as a central plant. Equipment has been developed to handle loads of all sizes, and cost is tending to drop as more and more factory assembly and prepackaging is being done by the manufacturer. Commercial installations are, more often than not, excellent prospects because the cooling load often equals or exceeds the heating load, thus allowing the inherent efficiency of the heat pump to pay off.

Major commercial markets for space heating in 1961 are expected to be schools, motels and apartment buildings. Schools and motels are holdovers from 1960. Apartments have begun to fall into line only recently. Internal heat gains and the heat storage capacity of the building itself frequently make electric operating costs highly competitive. Also, first costs are generally less. This statement holds true for year-round air conditioning with electric heat pumps as well as radiant panels or baseboards.

Penalties which some local FHA authorities have placed on electric space heating have not all been lifted, but the problem has been considerably lessened. The national administration has stated its position quite clearly as being not opposed to electric heat, having lifted most penalties and lowered down payments and income requirements. These moves are certain to stimulate electric heating.

Equipment

Electric resistance heating equipment in 1961 will not be noticeably different from the past year. Some restyling will be done, but no significant changes or developments. Safety is receiving closer attention, as manufacturers are developing improved thermal cutout methods in their baseboard lines to eliminate any chance of overheating due to obstructed heaters.

New baseboard models will also be offered with an option of a built-in or wall-mounted thermostat, and prospects look good for a price drop for low-voltage thermostatic controls. Continued interest is being shown in baseboard heating, which now appears to be capturing a major share of the market. Noticeable gains have been made in the use of drop-in floor heaters, suitable for use in the ever-increasing number of homes with floor-to-ceiling windows. Of significance is the emergence of electric furnaces and duct heating devices, some by warm-air heating equipment manufacturers in sizes to match their gas and oil product lines. While the primary market for this equipment will probably be residential, many applications will be found among small commercial customers. At least one central air-conditioning and heating system is planned embodying an air-conditioning unit and a tempering resistance heater at the central plenum plus thermostat-controlled supplementary heaters at the duct outlets.

Distribution and Installation

Continued experience suggests that in the long run, the regular electrical distributor is the one who is the most reliable to distribute heating equipment. However, the situation in a local area may often dictate different conditions. Specialty distributors have come and gone in many areas after encountering financial difficulties.

Because of the importance of adequate and careful insulating techniques, at least one heating manufacturer is encouraging his dealers to work with insulation contractors. On the other hand, one of the leading insulation manufacturers is looking hard for good electrical contractors to sell and install the entire heating job. Both approaches have merit.

Unfortunately, there are also several manufacturers who have entered the field with the intent of "skimming the cream." Their products are not well engineered and their field staffs are inexperienced. Utilities will have to exercise great care in the next few years, or until the industry shakes down, to avoid a rash of poor installations and dissatisfied customers. Utilities can certainly help by increasing their policing activities. However, pinpointing the responsibility—manufacturer or utility—has always been a controversial subject upon which there is no general agreement.

The All-Weather Comfort Standard has recently supplemented the existing NEMA standards. All segments of the industry do not strongly support them both; however, there is general agreement that they provide a firm basis of development and that they are the types of standards which can be used safely by utilities in establishing their regulatory requirements.

All-Electric Residence

. . . has two distribution centers for 16½-kw lighting load plus 220-volt service for cooking, space heating, hot water and complete air conditioning.

A RESIDENCE representing gracious electrical living at its best is located in Fresno, Calif. This home is admittedly larger than average, containing four bedrooms and baths, a 3-vehicle carport, game room and enclosed loggia in addition to large living and dining rooms, kitchen and breakfast nook, laundry and air conditioning facilities. Few homes match this one in size or electrical scope, yet many of the practical ideas designed into this deluxe residence can be advantageously adopted, either en-masse, piecemeal or on smaller scales, by any contractor or home owner interested in electrical up-grading.

Consider first the attractive brick exterior of this 135-ft-wide single-story dwelling. As indicated by an accompanying photo, facade entrances, thresholds and bordering planter arrangements are highlighted by 75-watt floodlamps recessed on approximate 14-ft centers into the roof overhang. This downlight treatment continues completely around the house, involving a total of 32 such fixtures.

It will also be noted that the front entrance is additionally illuminated by an incandescent unit consisting of a 200-watt lamp shielded by a perforated metal bowl suspended beneath a 3-ft recessed dome; a treatment that is duplicated in eight additional locations to illuminate an interior entry area, the enclosed loggia and a covered terrace overlooking an underwater-lighted swimming pool located at the rear of the home.

LARGE LUMINOUS PANELS over kitchen and adjacent breakfast nook plus local lighting above sink, electric cooking island, wall-recessed ovens and indoor barbecue provides 50-100-fc illumination pattern in shadowless fluorescent-incandescent combination.

Landscaped grounds and pool area are also lighted by floodlights aimed and shielded to preclude glare from normal viewing angles, while ornamental post lanterns provide a decorative outline for a sweeping driveway that encircles a flowered island.

Inside the dwelling, primary interest of housewives centers around the kitchen, where general illumination in the order of 50 fc is obtained from two separate central luminous-ceiling areas located over the kitchen proper plus the related breakfast nook. These two lighted areas (jointly containing 48 RS 40-watt fluorescent lamps) are physically separated by a suspended copper ventilating hood that contains an R-40 downlight to illuminate a pushbutton-controlled all-electric cooking island.

With rapid-start ballasts, noise level is at a minimum. With deluxe cool-white lamps mounted on 2-ft centers, shadowless illumination of good color quality is obtained. With plastic diffusing panels suspended 18 in. beneath lamps, diffusion is uniform. And, with these lighted plenum chambers recessed so that diffusing panels are flush with bordering ceiling areas, the lighting installation blends well with the overall structural design.

Local work areas are additionally illuminated. A recessed 4-lamp fluorescent troffer with vinyl diffusing panel is placed above the sink, and adjustable floodlamps are re-

DOWNLIGHTS recessed into roof overhang of this dwelling, dome-lighted entrance thresholds and ornamental post lanterns illuminate brick facade of residence, walks and driveway, landscaped grounds and shrubbery.

cessed above built-in electric wall ovens in addition to the downlighted ventilation hood previously mentioned. An accompanying illustration also shows the presence of an electric dishwasher which, together with a garbage disposal unit, a wealth of convenience receptacles for appliances and other lights in enclosures such as towel-rack compartments and an indoor barbecue, contribute to a labor-lightened, efficient food-preparation center.

This area is decorated in 70% RF off-white, 50% RF wallpaper featuring a turquoise flowered pattern on beige background, natural birch woodwork, a brick wall surrounding the ovens and barbecue, plus the copper ventilation hood. The environment is pleasingly inviting and, with shielded incandescent sources combined with the large luminous fluorescent areas, excellent seeing conditions are combined with fine color quality.

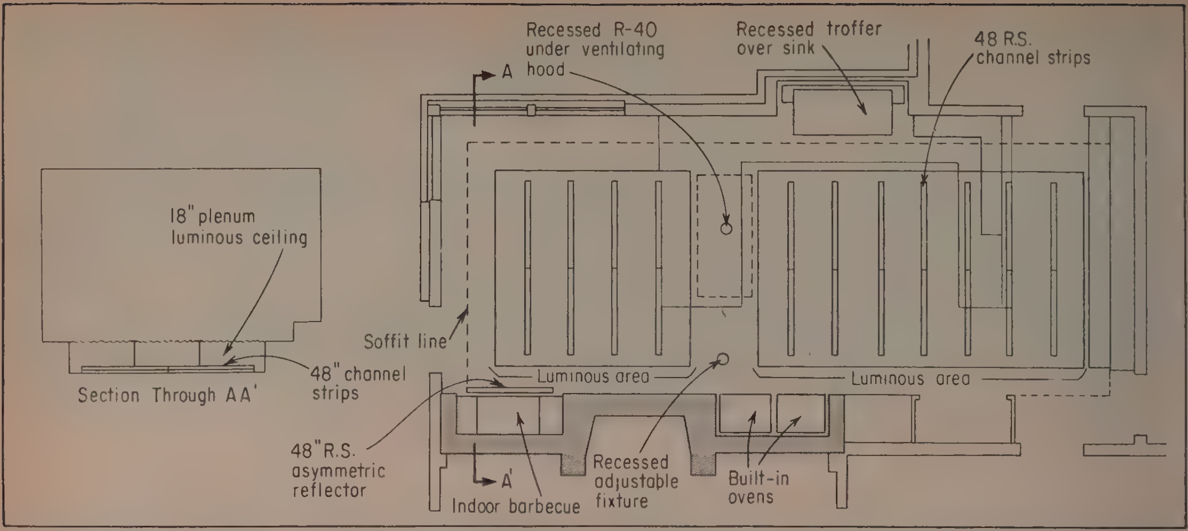
Another attractive area is the game room which features natural wood and brick walls, tile flooring, leather-upholstered furniture and wall-to-wall window drapes top-lighted by coved fluorescent single-lamp strips mounted continuously. It will be noticed that this room is equipped with a pull-down luminaire and cluster of indirect reflector units in addition to 3-intensity table lamps placed alongside all reading locations. On the same side of the room from where the accompanying photo was taken, an L-shaped bar is top-lighted by a 3- by 9-ft recessed luminous panel (containing four-40 watt deluxe CW lamps), while all walls are liberally provided with duplex and triplex convenience outlets located either 12 or 44 in. above the floor, depending upon designed applications.

Living, dining and bedrooms all incorporate lighted valances along one, two or three walls, while a deep 32-ft-long cove containing two continuous rows of RS WWX fluorescent lamps provides a wide blanket of indirect illumination for the loggia. Deluxe WW lamps likewise are placed in soffits above fireplace-flanking planter boxes in the living room, while central illumination in the adjoining vaulted dining room is provided by a beautiful crystal chandelier.

Bathrooms throughout the house are centrally lighted by surface-mounted luminous panels; all make-up and wash-stand mirrors are top-lighted by recessed vinyl-panelled 4-lamp fluorescent fixtures; shower stalls are equipped with recessed 60-watt incandescent vapor-proof units; time-control switches operate exhaust fans; hot water is provided by several centrally located 220-volt electric heaters; and wall-recessed 220-volt radiant heaters provide local fast-pickup warmth to these rooms.

Other electrical features in the house include split-circuit convenience outlets, with upper receptacles hot and bottom receptacles switched from doorway locations; an intercom system with 2-way speakers in

GAME ROOM offers lighting variety through mediums of window-wall valance, ornamental pull-down luminaire, cluster of indirect fixtures, several table lamps plus large luminous soffit above bar located on "this" side of the room.



LIGHTING INSTALLATION in kitchen precludes glare by shielding, recessing and diffusing all light sources. Efficiency of kitchen is also promoted by electric stove and ovens, dishwasher and food disposal unit, refrigerator and freezer, duplex outlets for appliances, exhaust hood and complete air conditioning, telephone and intercom stations.

LOGGIA is illuminated by recessed domelights plus deep cove containing two continuous rows of warm-white deluxe fluorescent lamps. Note planter boxes in distant hall toplighted by recessed floodlights; heating registers in floor; thermostatic control on wall; sliding glass doors leading out to sheltered terrace.

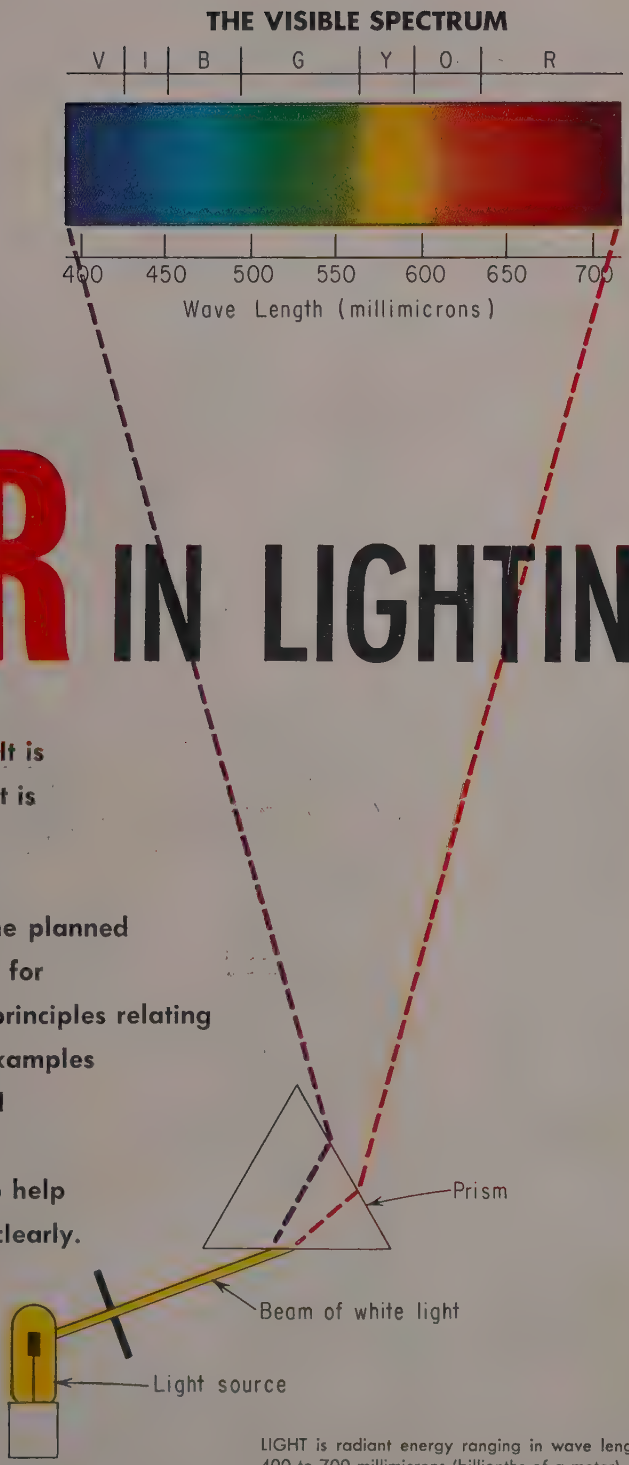
all living and work areas; phone outlets or jacks in all bedrooms as well as in the kitchen, game room, loggia and covered outdoor terrace; remote control of exterior lights from the master bedroom; dimmer controls for lighting in several living areas; numerous weatherproof outlets around the grounds and terrace to further outdoor electric living; low-voltage switches incorporating pilot lights where switches control either exterior lighting or lighting not in the same room with the switches; complete air conditioning and underground service entrances for telephone as well as for two 110/220-volt power panels. Both panels have 200-amp main breakers. Lighting load totals 16½ kw.

FIREPLACE of living room is flanked by planters toplighted by soffited WWX RS fluorescent striplights while opposite end of room is illuminated by 3-wall continuous valance surmounting windows overlooking floodlighted terrace and swimming pool. Room is also equipped with 2-way intercom station, coaxial cabled TV outlet, eight split-circuit (hot and switched) duplex receptacles and two light-control centers.

COLOR IN LIGHTING

Color is inherent in all visible lighting. It is involved in the process of seeing. Yet, it is seldom given deliberate consideration in lighting design and application. For these reasons, and to help stimulate the planned use of color in lighting for function and for decoration, some of the fundamental principles relating to the physics of light and color, and examples of typical applications of the functional use of color in lighting, are presented here. Full color illustrations are used to help present the principles and ideas more clearly.

by Berlon C. Cooper



LIGHT is radiant energy ranging in wave length from 400 to 700 millimicrons (billionths of a meter), which is perceived by the eye as color. A beam of white light, which contains all visible wave lengths, can be dispersed by a prism into its separate wave lengths, as shown here, to produce what is commonly known as the visible spectrum.

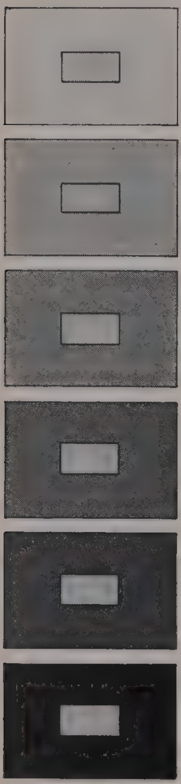
Physics of Light and COLOR

COLOR in lighting has significance for everyone. It is an important factor in the process of seeing. It affects *how* people see, and *what* they see. Its significance is comparable with that of levels of illuminations, brightness contrasts and glare, and other technical considerations which lighting engineers have used in lighting system design through the years.

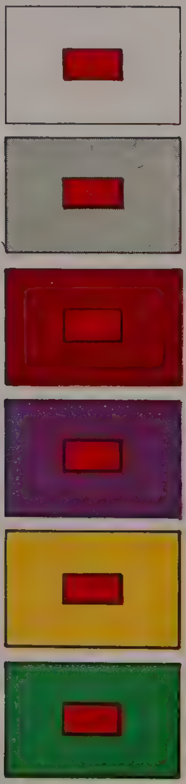
There are very few people, however, who are aware of, or understand, the importance of color as a factor in seeing, and hence, its importance as a factor in lighting design. Most individuals, including lighting industry people, think of color in lighting merely as a means to dramatic color lighting and decorative effects only. This, of course, is a valid and understandable consideration, and an end-use application which should be further refined and developed. The real importance of color as a factor in lighting design, however, is in its intelligent application to improve vision, to enable people to see what it is

[Continued on page 111]

Simultaneous Color Contrast and Brightness Contrast

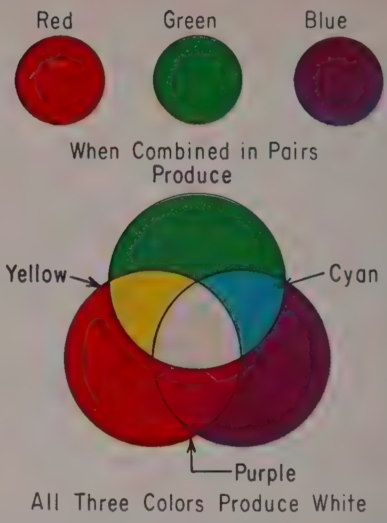


BRIGHTNESS of the small center rectangle in each larger rectangular background above appears to increase when viewed from top to bottom. Its brightness remains constant, however, and it is the background brightness which varies.



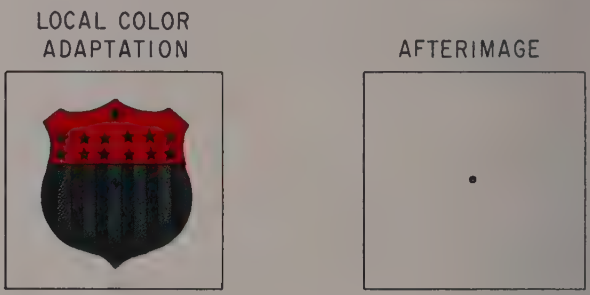
APPEARANCE of a color is influenced by its surrounding area, as is shown above. The center rectangle is the same color in all cases, and only the color of the larger rectangle is changed.

The Primary Colors of Light


Red
Green
Blue
When Combined in Pairs Produce
Yellow
Cyan
Purple
All Three Colors Produce White

THREE COLORS of light — red, green and blue — form the so-called "additive primaries." With these three colors only it is possible to form any desired color, including white. When combined in pairs, in equal intensity as shown above, the complementary color of the third primary is produced.

Complementary Color Afterimage

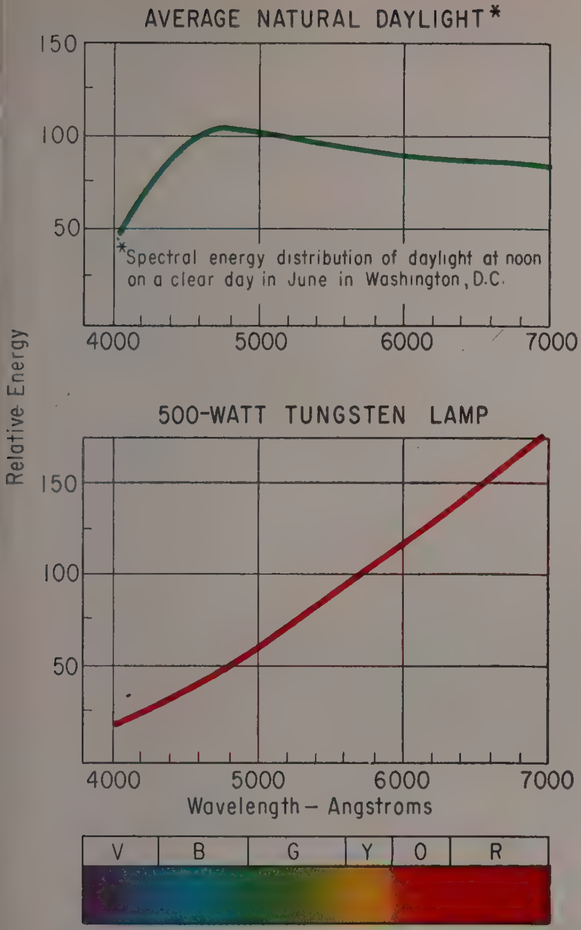


AN AFTERIMAGE of an object is seen in complementary colors. For example, stare at the black dot in the shield above, for about half a minute under a bright light, then quickly look at the black dot in the white background (at right). The orange area changes to blue, the blue-green stripes change to red, and the black areas become white.

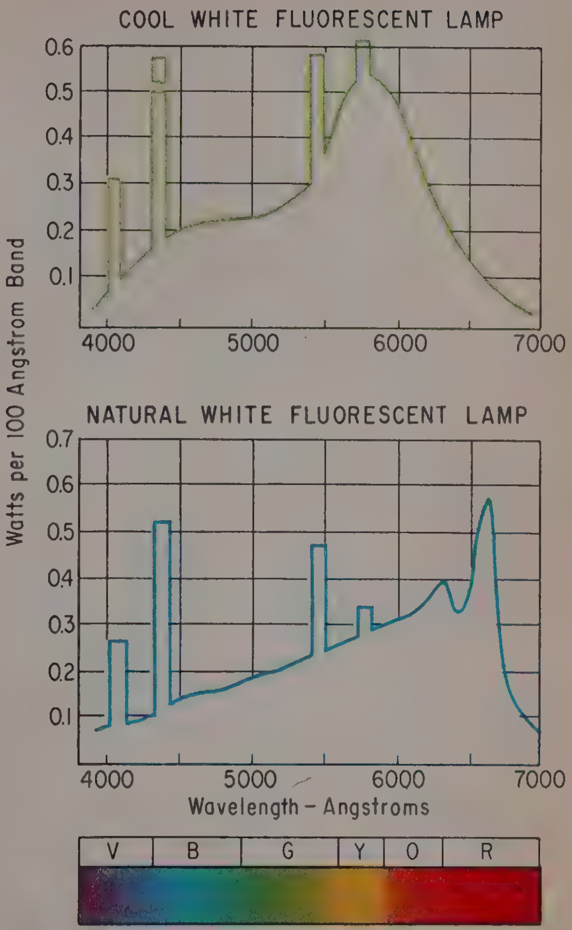
COLOR COMPARATOR is used by the Dallas Power and Light Co., Dallas, Texas, to demonstrate the color values of six different light sources. Each segment of the comparator contains a different type of lamp. Back side of the comparator is closed in by a hexagon-shaped board, and sides of each segment are painted flat white. Several removable back panels are available, each painted in a different color. Lamp for each segment is switched on separately, and it is therefore possible to view and compare the actual background color under any one or all of the six different light sources, individually or simultaneously.

EFFECT of changes in color quality from one light source to another on the "apparent" color of an object is demonstrated at far right. Actual color of removable back panel, shown at left of each pair of hexagons, has a different "apparent" color under each different light source, proving that "color is how you light it." It should be noted, however, that the "apparent" color of an object, as seen when viewed under any particular light source, is just as real as the so-called "actual" color.

Spectral Quality of Light Sources



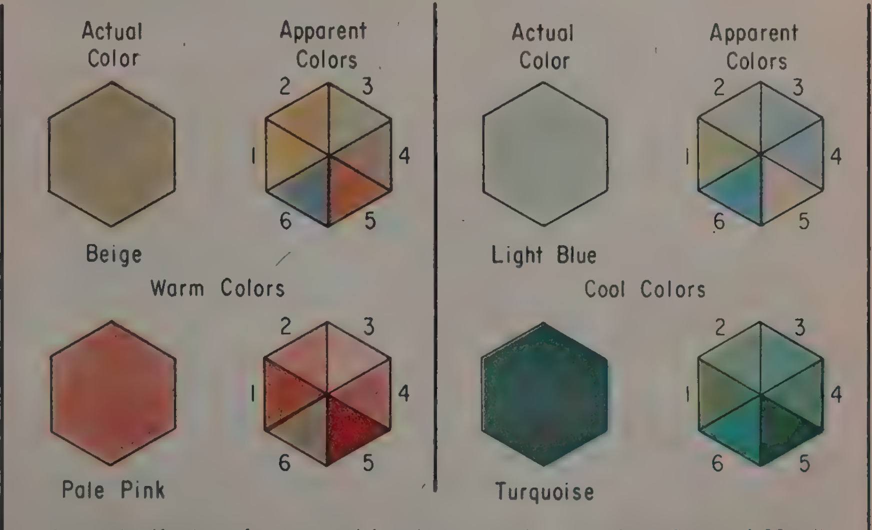
Source: G.E. Co., Lamp Dept.



Source: Sylvania Lighting Division

COLOR QUALITY of a light source can be established with great accuracy by means of a spectrophotometer, in which a wavelength analysis of the visible energy is made. The spectral distribution curves shown above, obtained in this manner, are typical examples. Note that a tungsten lamp is rich in orange and red energy, which accounts for its yellow-reddishness appearance when compared with noon sunlight. Also note that the natural white fluorescent lamp has more red than the cool white fluorescent lamp, which gives it a warmer appearance.

Color of Light Sources



Note – Identification of lamps used in color comparator: Incandescent lamp – 1. 60 watt., Fluorescent lamps – 2. white; 3. cool white; 4. deluxe cool; 5. home line; 6. daylight.

COLOR IN LIGHTING APPLICATION

THE importance of "color" in lighting is much greater than has been generally recognized. This importance becomes evident in an analysis of light and color, and how we see. Some of the simple fundamentals of the physics of light and color are presented on the preceding pages.

Good lighting design, based on contemporary lighting needs, involves three basic factors. These are: 1) adequate lighting (footcandles) for the seeing tasks involved; 2) minimum glare, or low ratios for brightness contrasts; and 3) correct color quality of light. The first factor has long been recognized and used by lighting engineers, and the second has been given increasing consideration over the past decade. Now, with the growing recognition of the importance of the "quality" of light for living, commerce and industry, color in lighting must also be given greater consideration.

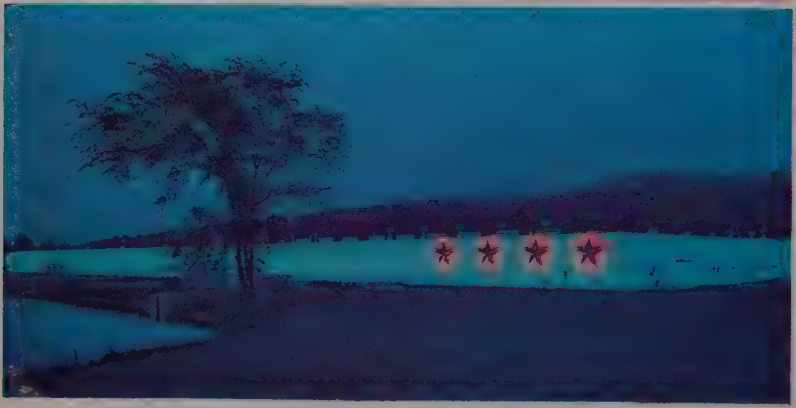
Some typical examples of how color in lighting can be used functionally, as well as for aesthetic purposes, are presented and described in detail on this and the following pages.

● FLOODLIGHTING

Blue Fluorescents FLOODLIGHT RURAL FACTORY

Diffuse light distribution from fluorescent floodlights creates dramatic nighttime appearance for plant of Star Expansion Industries Corp., in picturesque setting near Mountainville, N. Y. *(See page* 112)

FACTORY of Star Expansion Industries Corp. nestled among hills near Mountainville, N. Y., presents attractive appearance to motorists on nearby New York State Thruway, by day and by night.



BLUE HAZE of approaching nightfall is matched by hues of blue floodlighting over a 20,000-sq-ft area of plant's building facade. Brightness uniformity is result of diffuse light distribution provided by Fluoroflood fluorescent weatherproof floodlights.

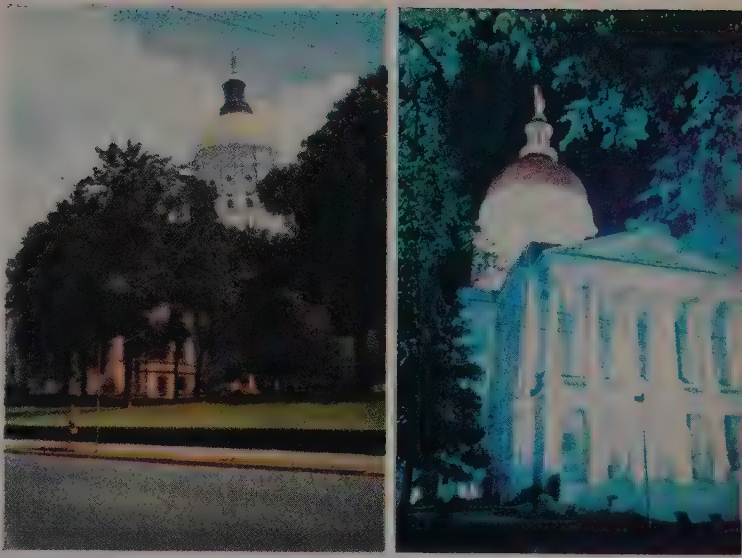
LIGHT ADDS BEAUTY

to Georgia Capitol Building

Different types of light sources provide striking color contrast in floodlighting installation. (*See page* 112)

GOLD DOME of Georgia's State Capitol, in Atlanta, shines brightly by day, and is a familiar landmark visible from many sections of the city.

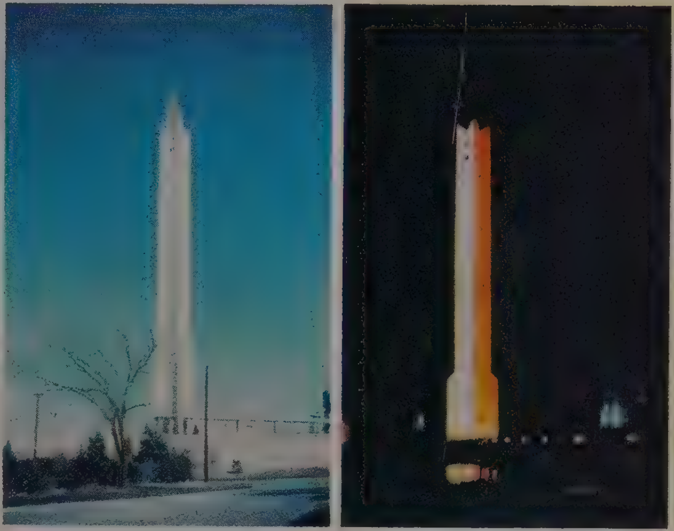
FLOODLIGHTING has now been added to softly light main building at night in bluish white rays of mercury floodlights, which contrasts harmoniously with soft yellow radiance of incandescent lighting on super structure elements.



COLOR-CONTRAST FLOODLIGHTING

Use of two colors for floodlighting church bell tower reveals shaft's shape, and provides a dignified and inspiring nighttime appearance. (*See page* 112)

SUNLIGHT reveals the shape and beauty of the bell tower of the First Christian Church of Oklahoma City, by day with highlights and shadows. Floodlights add new beauty at night, with white light on north and south sides, and amber light on east and west sides, to reveal missile-like shape.



DISTINCTIVE FLOODLIGHTING

for New York Skyscraper

Mercury lamps in special floodlights bathe the aluminum-surfaced Tishman Building in New York in distinguishable bluish-white light, individual in appearance, and visible for miles. (*See page* 115)

DISTINCTIVE color of mercury lighting gives individuality to the Tishman Building at 666 Fifth Ave., New York City, at night, when viewed from close range or on the New York skyline from several miles away. The bluish-white light is highly effective on the aluminum surface of this 38-story office building.

COLOR IN LIGHTING FOR FUNCTION

Display Room Uses
COLOR-IMPROVED LIGHTING

Pink reflectors and pink-finished ceiling in plenum cavity improve color quality of light produced by plastic louver ceiling lighting system.
(See page 115)

COLOR QUALITY of illumination in display room of Briggs Mfg. Co., New York City, is custom designed to reveal true colors of merchandise. Lighting is combination of incandescent, and cool white fluorescent in which blue and green light is filtered with pink reflectors to provide a better color balance to the general display area lighting.

FILTER DIFFUSERS
Improve Color Quality

Kansas manufacturer uses color-balancing diffuser panels in luminous ceiling, to provide light of color quality suitable for analysis and appraisal of product colors and finishes.
(See page 116)

FILTER diffusing panels used in luminous ceiling of the Design Conference Room, The Coleman Co., Wichita, Kansas, "cools" the light from cool white fluorescent lamps, and provides an improved color quality of light through a rebalancing of the spectral energy distribution of the lamps.

Light and Color Enhance
ENVIRONMENT FOR DINING

Theatregoers and others enjoy a comfortable visual environment and restful atmosphere when dining in New York's light- and color-conditioned Playbill Restaurant. *(See page* 116)

LIGHT and **COLOR** are combined most effectively in the Playbill Restaurant, Hotel Manhattan, New York City, to create a warm and highly attractive environment. A comfortable lighting level is provided by recessed incandescent lamps, and by soft white fluorescent lamps above textured plastic panels in center of the ceiling domes. Low wattage incandescent lamps in ornamental luminaires add a decorative touch.

ILLUMINATOR provides 3800°K color-balanced light for viewing color transparencies. Unit uses two Philips 30-watt T12 Deluxe white fluorescent lamps. By using standardized units, critical color judgment of color transparencies is possible by editors, engravers and quality checkers in different locations.

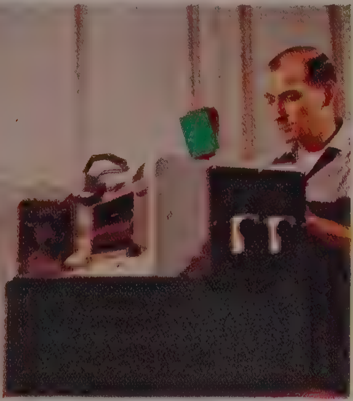
COLOR-BALANCED LIGHT

Aids Color Judging

Use of special fluorescent lamps provides standardized lighting for critical color judging.

(See page 121).

PRECISE color matching, for color differences so subtle that the eye cannot detect them, is done electronically by a special spectrophotometer. This instrument provides a highly precise spectral energy distribution curve for a color test sample, which is basic information for all color work.



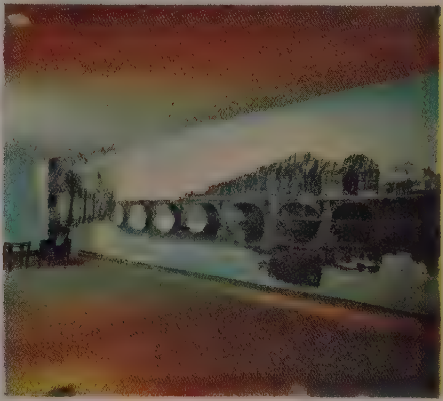
COLOR IN LIGHTING

in Product Research

Self-contained Color Laboratory of Rohm & Haas Company uses "color in lighting," and a variety of scientific instruments and devices for color analysis in the study of product color problems.

(See page 121)

ILLUSION of distance in this impressive mural, which features a typically Gallic scene of the River Seine, is heightened by special lighting. Its appearance is made even more realistic by control of the color quality of the light. It greets visitors to the reception area of Bourjois, Inc., on Fifth Avenue, New York City.



3-D REALISM IN MURAL

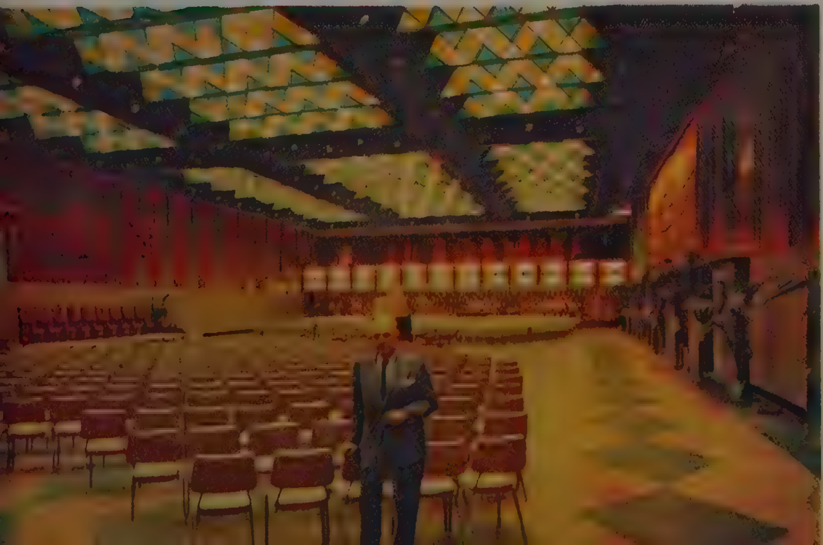
Through Lighting

Dimmer-controlled reflector lamps and soft white fluorescent lamps, provide flexibility in quantity and color quality of light for a variety of dramatic effects on a startlingly realistic mural.

(See page 122)

COLOR IN LIGHTING FOR DECORATION

MULTI-COLOR LIGHTING *for Light and Decoration*



The Canadian Room in the Royal York Hotel, Toronto, is lighted by a highly flexible lighting system which permits variations in lighting levels, spectral quality, and decorative effects.

(See page 122)

LIGHTING is an integral part of the decoration in this multi-function banquet room, or auditorium. General lighting is provided by fluorescent lamps above the three-color luminous ceiling panels, and is supplemented by incandescent downlights recessed in the lower angled plaster surfaces, and other special lighting units. All light sources are dimmer-controlled.

Color Lighting Provides VARIABLE ENVIRONMENTS

A variety of lighting elements in the club room of American Legion Post No. 5, Pittsburgh, Pa., makes possible everchanging lighting effects end decorative treatments. (*See page* 125)

Tinted Louvers IMPROVE LIGHTING QUALITY

Yellow louvers in lighting system add delicate tint to lighting to enhance the confectionery displays. (*See page* 126)

Highlights and Shadows EXPAND DECORATIVE EFFECTS

Use of two complementary colors provide apparent white light when blended in proper ratios, and also enhance the decorative effect by producing dramatic shadows in color. (*See page* 126)

CHANGING patterns of color in this club room permit a wide variety of lighting effects. Luminous ceiling is hexagon-cell aluminum louvers, lighted by silver-bowl incandescent lamps. Color boxes in ceiling are each equipped with three colored lamps—red, green and blue.

YELLOW LOUVERS in luminous ceiling add decorative effect to interior sales area of Barton's Bonbonniere in New York City, and provide desirable tint in light for more effective display of chocolate candies and packaging. Basic lighting is from louvered housings.

COLOR SHADOWS provide added attraction value to show window display in Higbee Co. store, Cleveland. One yellow and three blue reflector lamps provide essentially white light where they blend on the merchandise, and dramatic colored shadow effects on the background.

Add Beauty to GARDEN LIGHTING

The beauty of gardens, lawns and grounds can be greatly enhanced by the judicious selection and use of color in lighting. (*See page* 126)

Incandescent Lighting

LIGHT extends the beauty of flowers, shrubs, trees, statuary, etc. from day into evening; and the use of colored light, properly selected and applied, can transform a garden vista into a fairyland.

Black Light Lighting

BLACK LIGHT lighting is highly effective when used to light certain phosphorescent rocks, fountains, shrubs, etc., which are located in areas of complete or near-darkness.

PHYSICS OF LIGHT AND COLOR

(*Continued from* 104)

intended that they see, and for other functional purposes.

There are many reasons why there is a lack of knowledge, by the average person, of the real significance of color in lighting. While the physics of light and color and the process of seeing have all been determined and published, there has been relatively little popularization and dissemination of this information. Also, there has probably been confusion with respect to whose job it is to plan, specify and promote the latent qualities and benefits of color in lighting. Many have considered this as within the province of the architect, the interior designer, and the decorator. This is due primarily to the limited concept of color in lighting as a tool for color lighting and decorative treatments. On the other hand, these professionals—architects, interior designers, decorators—have also recognized the need for better color quality in lighting, but have considered this within the province of lighting consultants, electrical engineers and other specialists in the field of lighting.

Taking all these factors into consideration, it has been concluded that color in lighting is the logical business of the designers and specifiers of lighting systems. If this conclusion is valid, it is then also the logical business of the designers and producers of lighting equipment and accessories—manufacturers of light sources, luminaires, light control devices, etc. The lighting industry is already providing the tools and the techniques to solve lighting application problems in the home, in industry, in commerce, and in sports and recreation activities, and elsewhere. The field of color in lighting is merely the addition of another problem in lighting application. Most aspects of this problem are already familiar to the lighting industry, and to the designers and specifiers of lighting systems.

In the final analysis, however, it is still the architects, designers, decorators and owners who usually determine the final lighting results, or lighting effect, which is desired. It thus becomes the responsibility of the lighting industry—producers, specifiers, distributors, and installers—to work ever more closely with the architects, decorators, owners, etc. to provide complete lighting systems which accomplish the ultimate in lighting quality, including an appropriate color quality of light for each applicaiton.

It is on these premises, and on the recognition of the need for greater dissemination of information on the subject of color in lighting that this special editorial feature is presented. It is believed that color in lighting provides the lighting industry with a new opportunity for improvement and expansion of its product, *quality lighting*, for mankind. It also provides an excellent theme for promotion of expanded lighting markets, or even for a new industry-wide lighting program.

Light and Vision

Light, by definition, is radiant energy which, by its action upon the organs of vision, enables them to perform their function of sight. Radiant energy within the light-producing section of the electromagnetic spectrum ranges in wavelength from about 400 to 700 millimicrons. The color of light depends upon the predominant wavelengths of the radiation (see "The Visible Spectrum").

Vision occurs when radiation of wavelengths between 400 and 700 millimicrons pass through the lens of the eye to the rods and cones of the retina, and set up pulsations which proceed along the optic nerve to the brain. This action is experienced as a sensation of seeing light. Thus objects are seen as light which is reflected from them, or as something which emits light.

Objects are selective in their reflection of light. That is, they absorb light of color that is different than the color of the object. For example, an object which is green reflects light whose wavelength is predominantly around the 530 millimicron or green band, and absorbs the other colors, or the other wavelengths of light which fall upon it. Thus the eye sees the object as green. In this example, however, it is assumed that the light falling upon the object contains radiant energy in the 530 millimicron band, otherwise the object would appear black.

When light containing all the wave lengths between 400 and 700 millimicrons, in certain quantities having nearly equal sensitvity to the eye, is perceived by the eye, the sensation of colorless or "white" light is experienced by the individual. Thus the eye is not selective; it responds simultaneously to all radiation within the visible spectrum, regardless of wavelength. Light of a specific wavelength can be distinguished by the eye only when it is presented alone.

Color in Lighting

It is not intended, in the limited space available here, to discuss the physics of light and color in detail. The objective, rather, is to point out that there is an inseparable relationship between light and color, and that color is a definite factor in the visual process. This being so, it follows logically that the design of a lighting system is not complete without the consideration of color in lighting. This consideration should be from two standpoints: 1) the color of objects to be seen—the physical surround, such as furniture, machinery, floors, walls, ceilings, etc., and objects classified as the "visual task"; and 2) the "color" and spectral characteristics of the light to be used in the area. *How* the color of the light affects the color of the objects to be seen is revealed by the laws of physics relating to light and color, and to the process of seeing.

Presented on the first three pages of this article are some typical examples of the science and physics of light and color, in four-color printing. The captions merely give the basic highlights of the principles involved in each case. For those individuals who want to study these and other color in lighting principles further, Chapter 5 of the 3rd edition of the *IES Lighting Handbook* is recommended, including any of the various reference sources listed at the end of the Handbook Chapter.

In addition to the illustrations relating to basic color in lighting principles, full- color pictures covering 15 case histories of the use of color in lighting for function or for decorative purposes are also presented. Lighting details and explanation of the color in lighting considerations are also presented for each case history.

FLOODLIGHTING RURAL FACTORY

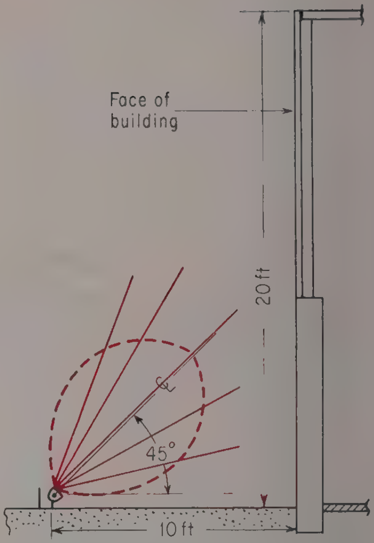
(*Continued from* 106)

MOTORISTS using the New York State Thruway at night near Mountainville, N. Y., experience a very pleasant visual treat. At a distance of about 500 yds from the northbound lane of the highway is the modern 20-ft-high plant of Star Expansion Industries Corp., uniformly lighted in a rich blue color which harmonizes with the blue shadow vistas of the mountainside background. Contrasting pleasantly with the rich blue color is the silhouette lighting of four stars by means of concealed red neon tubing.

By day, the vista is equally pleasing and beautiful. The four stars stand out boldly in red against the tan and beige color of the building's facade, which in turn nestles harmoniously in a setting of green provided by the forest behind the plant.

The front and side of the plant, extending over 1000 ft in length, are lighted by 77 Fluoroflood reflector units. Each unit is equipped with an F72T12/B/HO high-output, rapid-start, 6-ft-long lamp. A two-lamp ballast is used to operate the lamps in each two adjacent units, and is of the type designed for operation in a minus 20-degree temperature. Light output of this blue fluorescent lamp is 21.8 lumens per watt, which compares with 1.2 lumens per watt for an incandescent lamp equipped with a blue filter.

The floodlights are mounted 8 in. above the ground at a point 10 ft out from the base of the building, and on 14-ft centers. The units are aimed upwards at an angle of 45 degrees. Because of the diffuse character of the light distribution from these units, they light the 20-ft-high building evenly, uniformly, and efficiently and with a minimum of wattage.



LOCATION of floodlights is a factor in providing a uniform brightness on the building's exterior surface and high lighting efficiency.

LIGHT ADDS BEAUTY

(*Continued from* 107)

RECENT renovation of Georgia's State Capitol Building in Atlanta, built in 1884, included exterior floodlighting, as well as rewiring and relighting throughout. As part of the renovation, a main dome and cupola dome were covered with gold leaf, donated by the citizens of Dahlonega, Ga., where the gold was mined. The floodlighting was desired to reveal the beauty of these gold domes, as well as to flood the exterior of the main building, the vertical base of the dome, the cupola, a Statue of Freedom atop the cupola, and the lighting of a torch held high in the right hand of the statue. It was decided that maximum contrast between these building elements would create the greatest interest.

The lighting solution, arrived at after careful consideration of various light sources and combinations, was based on the use of four different light sources. These include deluxe warm Colortone mercury lamps to floodlight the lower or main section of the building, fluorescent lamps within the cupola, and incandescent lamps to floodlight the gold domes, vertical sections under the domes, and the statue, and a flame-colored incandescent to light the torch.

The main building and wings are lighted with 400-watt mercury Colortone lamps in floodlights which are pole-mounted around the perimeter of the building.

The main dome and the vertical section under the dome are lighted with 500-watt PAR-64 reflector lamps, of the narrow, medium and wide beam types. Floodlights which are focused on the gold dome are equipped with medium straw colored lenses. Also mounted on roof are eight narrow beam 500-watt spots, two to a side, which light the cupola and statute.

In viewing the building at night, the color contrast between the main building, the dome section, the cupola interior, and the lighted torch is striking and dramatic.

This floodlighting project and the electrical system design and specification were all worked out by Bush-May & Associates, consulting engineers of Atlanta, under the supervision and guidance of L. Ralph Bush.

COLOR CONTRAST FLOODLIGHTING

(*Continued from* 107)

THE simple principle of contrast between light of different colors was used to effectively floodlight, and to functionally accent the shape and form of the bell tower of the First Christian Church of Oklahoma City, Okla.

The bell tower is one of four structures which constitute the church plant, designed by R. Duane Conner, architect of Oklahoma City. The other three structures are a dome-shaped concrete building, which is the main sanctuary, a four-story educational building, and a Fine Arts building. The bell tower is a tall, missile-shaped shaft which stands apart and separately from the other three structures. Its shape is intended as a tribute to youth, depicting the future.

The objective in lighting this tower was to make it as noticeable and inspiring at night as it is by day, to retain its shape, and to present a dramatic and pleasing appearance from close range as well

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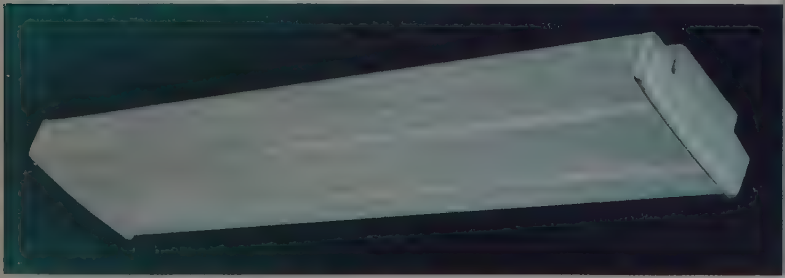

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In addition, PLEXIGLAS lenses remain free of discoloration even after years of exposure to fluorescent light. They are strong and rigid yet light in weight, resulting in safety overhead and ease of maintenance.

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as from a distance. It presents a narrow shape, with four rectangular surfaces each 12 ft wide and 130 ft in height.

The objectives were attained through careful selection of floodlighting units of appropriate beam spread and control, of locations for mounting the floodlights, and through use of the contrast of color on alternate faces of the tower. The floodlights were located, insofar as practical, about 60 ft from the base of the tower and at a point perpendicular to the tower surface. Narrow beam floodlights, with good overlapping light patterns, were selected to provide maximum illumination on the upper two-thirds of the tower with a minimum of spill light, and medium beam floodlights were used to light the lower one-third of the tower. Five floodlights, each using 300-watt PAR-56 lamps, are used at each floodlight location. Units which light the north and south tower surfaces are equipped with clear lenses, while units lighting the east and west surfaces are equipped with amber lenses. This arrangement contrasts the vividness of amber light with the white of incandescence.

This unusual lighting design treatment was worked out by the architect with the cooperation of Patrick U. Dunlop, lighting consultant with the Oklahoma Gas and Electric Company.

DISTINCTIVE FLOODLIGHTING

(*Continued from* 107)

ATTRACTING attention and establishing identification becomes ever more difficult, for new office buildings constructed in the City of New York, where more than 150 such buildings, 20 stories or more in height have been built over the past 15 years. This was the problem faced by Carson & Lundin, architects, and their lighting consultant, Abe Feder, during the planning of the recently-completed Tishman Tower building.

Mr. Feder's goal was to meet this problem, and to provide an "after-dark spectacular" by adding the extra dimension of lighting to office building architecture. The Tishman Tower, with its bright facade of sheathed aluminum, could be transformed into a shining shaft of light at night, glareless yet visible for miles. But simple floodlighting was not enough. The floodlighting had to be distinctive, and individualistic. It was thus decided that "color in lighting," achieved through the use of mercury lamps, would do the trick through the medium of its characteristic bluish-white light. This color quality would further accent and harmonize with the bright finish of the exterior surface of the building.

Analysis of the floodlighting problem itself indicated that existing light sources and floodlights would not meet the existing conditions and provide uniformity of illumination over the entire 38-story tower. Thus a new light source, a 1000-watt reflector lamp in an R-80 type bulb, 10 in. in diameter, was designed specifically for this project; also, a new floodlight with a special cone-shaped reflector, specifically designed to be used with the new light source, was specially designed for this job. The floodlight approximately doubles the beam candle power of the bare reflector lamp only.

The floodlighting solution consists of the use of 72 of these special 1000-watt mercury lamp floodlights, installed on the 10th and 15th floor setbacks of the building.

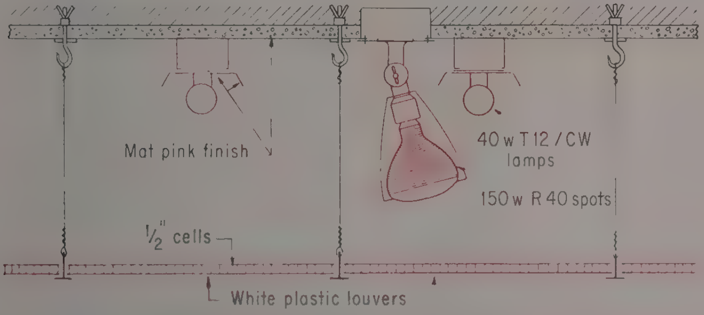
● LIGHTING FOR FUNCTION

COLOR-IMPROVED LIGHTING

(*Continued from* 108)

A SPECIAL "louverall" ceiling lighting system was custom-designed to provide color-corrected lighting for the Briggs Manufacturing Company showroom in New York City. The improved lighting was desired to give prospective buyers the best color quality of light possible for accurate appraisal of the company's entire line of colored bathroom fixtures and fittings which are featured in the various displays.

The new luminous ceiling lighting system, with plastic louver panels for shielding and diffusion, provides approximately 100 foot-candles throughout the area. It replaces an outmoded lighting system in which suspended two-lamp fluorescent luminaires produced less than 15 footcandles of non-uniform lighting, of unsatisfactory color quality.



SECTION THROUGH CEILING CAVITY

REFLECTORS over fluorescent lamps, and plenum cavity suurfaces, are finished in pink color, to absorb excessive blue and green output of fluorescent lamps; provide a color quality which accents warm tones in displays being lighted. Incandescent reflector lamps also supplement fluorescent illumination, and more red and yellow light to display area.

Color correction is built into the new lighting system. The system consists of a wall-to-wall ceiling of translucent white acrylic plastic louvers, supported on inverted T-bars and suspended 14 in. below the old acoustic panel ceiling, and 17 rows of cool-white fluorescent lamps plus eleven 150-watt adjustable spotlights, concealed above the suspended louver ceiling. The plenum ceiling and the reflectors above the fluorescent lamps were finished a warm pink. This pink color in the reflectors and on the ceiling serves as a filter for all reflected light. By absorbing some of the excessive blue and green light of the cool white fluorescent lamps, the pink reflectors give a better color balance to the resulting illumination which is directed to the display area below. Still more color correction is provided by the use of incandescent lamps which add red and yellow light to the room lighting.

The new lighting installation is part of a complete color conditioning renovation of the display area. Other color treatments include a new floor, and different colors on the varous walls, columns, etc. as attractive backgrounds for the various merchandise displays. The entire project was designed by Howard Ketchum, Inc., color, illumination and design engineers. The lighting equipment used was standard equipment except for the special pink finish on the reflectors.

ENVIRONMENT FOR DINING

(*Continued from* 108)

THE subtle use of light and color, to create a warm and aesthetically pleasing environment for dining, is artfully demonstrated in one of New York's newer restaurants. It is the Playbill Restaurant, in the Manhattan Hotel, located in the heart of Broadway's theatre district. As its name implies, it caters to show people and theatregoers, and its design and decor masterfully portrays the theatre in metaphor.

The Playbill occupies two floors, with a bar and cocktail lounge occupying the upper, or street-level floor, and two dining rooms, reached by a broad, carpeted, curving staircase, on the lower floor.

In the dining rooms, perimeter seating gives patrons the feeling of being ensconced in jewel-like theatre boxes, with the attendant enchantment of awaiting the appearance of their favorite stars in an exciting play. This illusion is further promoted by a subtly lighted stage setting at one end of the restaurant. Warm reds, pinks, gold and white create the background for luxurious dining in these areas.

The simulated theatre boxes, with deep red wall coverings, are each lighted by fluorescent lamps in a reverse cove at the top of the alcove wall, and by a twinkling chandelier, centered over the table. A 30-watt R20 lamp concealed in the center of the chandelier projects its light to the table and dining area, while clear lamps in crystal reflectors add a sparkling decorative touch.

Lighting in the central areas of the dining rooms is from recessed downlights, many with star cutouts, and from playhouse candelabra luminaires suspended from large soffit domes, in which a luminous central panel diffuses fluorescent light reflected from pink reflector surfaces through plastic which has the warmth, texture, sparkle and beauty of venetian glass. The luminaires are decorative only. Thus the utilitarian light is provided by incandescent and fluorescent lamps, dimmer controlled.

The Playbill interior was conceived, designed and decorated by Melaine Kahane Associates. The lighting was custom tailored with specific attention to color quality, by lighting consultant Abe Feder.

FILTER DIFFUSERS

(*Continued from* 108)

LIGHTING quality is equally as important as the quantity of light. At least, that is the conclusion of management at the Coleman Company in Wichita, Kansas. In selecting the lighting system for their Design Conference Room, it was decided to provide both, an adequate quantity of light, and a spectral quality of illumination which would make inspection and analysis of product colors and finishes simple and easy.

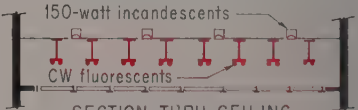
The conference room is 17 ft 9 in. long by 16 ft 9 in. wide, and has a 12-ft high ceiling. On the ceiling are steam pipes, sprinkler system, and air conditioning ducts, formerly exposed to view. In selecting a lighting system for this area, it was only logical that a luminous ceiling system was decided upon, installed at a height of 8 ft 6 in. from the floor.

The luminous ceiling consists of 24 in. by 48 in. Coloratron polystyrene, color-pigmented, plastic diffusing panels, installed on a T-bar grid construction. A mineral board was used around the room perimeter, to extend the ceiling to the walls from the luminous panel area. At a distance of 16 in. above the diffuser panels were located 14 fluorescent 2-lamp 8-ft luminaires, and two fluorescent 2-lamp 4-ft luminaires. These units were suspended 17 in. below the plenum ceiling. The entire 33-in. cavity above the diffuser panel ceiling was then painted white. Cool white fluorescent lamps were used.

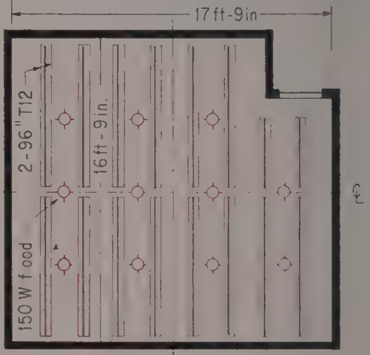
An overhead system of incandescent lighting was also installed. It consists of eleven 150-watt Type R40 flood lamps recessed in the cavity ceiling. This makes it possible to view products under incandescent lighting, same as that used in residences.

The color quality of the lighting is altered by the Coloratron filters through absorption of certain wavelengths of light, providing a new balance of the spectral energy distribution of the original source of light. The color temperature of the cool white fluorescent lamps filtered through the Coloratron filter diffuser panels, ranges between 7450 and 7550 degrees Kelvin.

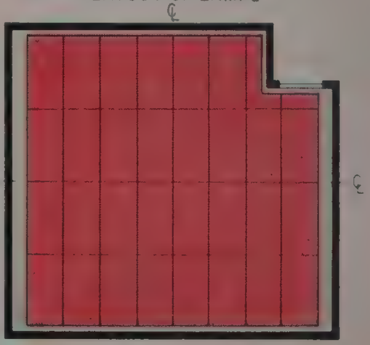
Filter panels change spectral quality of light



SECTION THRU CEILING



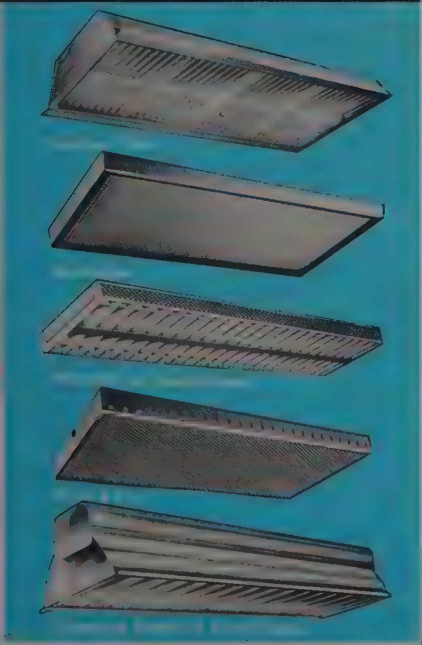
LAYOUT OF LAMPS



REFLECTED CEILING PLAN

THREE LEVELS of illumination are available in this installation: 1) all fluorescent lamps on—over 100 fc; 2) half of fluorescent lamps on—over 50 fc; 3) incandescent lamps only on—20 fc.

Shaw's Pharmacy, Allentown, Pa., lighted with Miller SABRE fixtur
Electrical Contractor: Glen C. Gorman, Allentown



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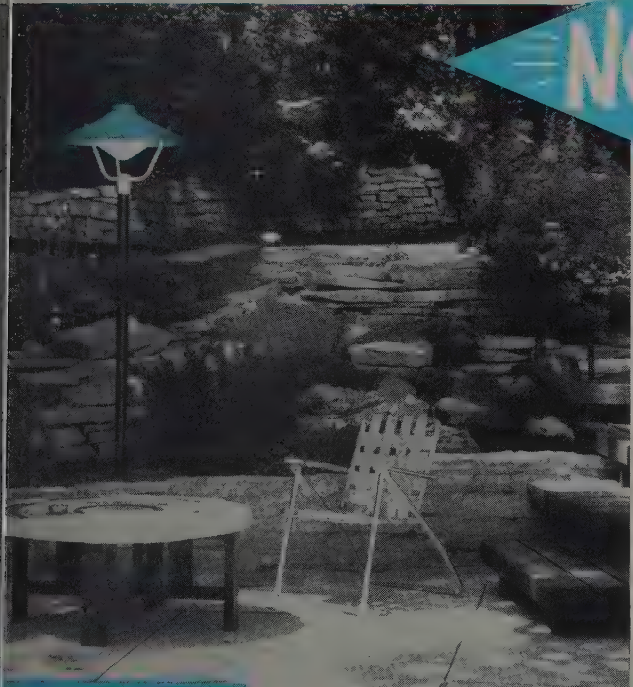
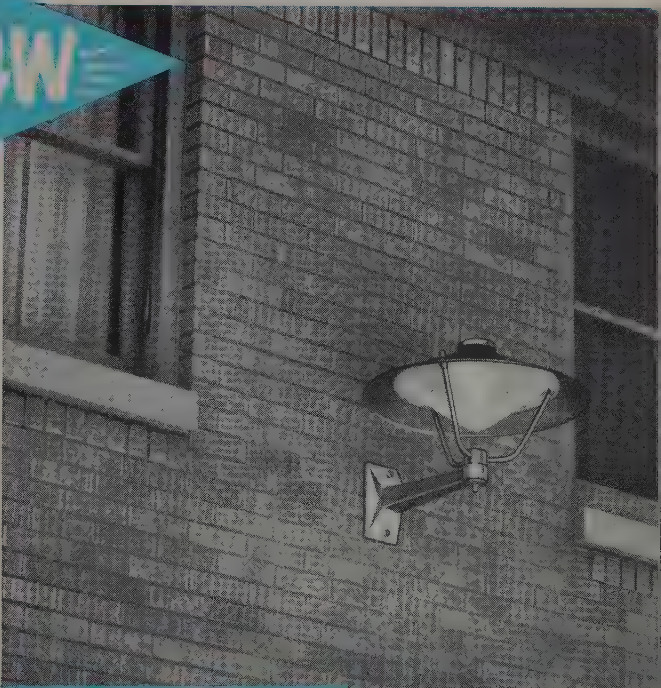
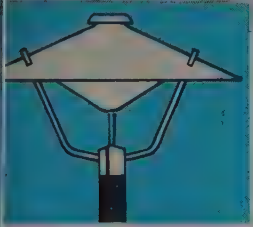
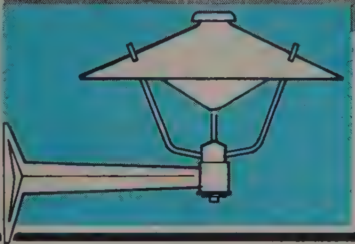
Lawn-Glo Lights Provide Quality For Home, Commercial Applications







One of L-M's newest Lawn-Glo lights, the Style C, provides soft, even light for this enchanting patio. Choice of six decorator colors and natural brushed aluminum.



Another new Lawn-Glo, the Style B, is this wall mounted unit. Lamp socket is an integral part of reflector and simply disconnects from the lighting fixture. Lawn-Glos accommodate standard lamps to 150 watts.

Line Material has added two more matching styles to its outstanding line of Lawn-Glo lights. This gives you a choice of excellent quality units. They offer a wide potential for both home applications and commercial uses: provide soft lighting and smart appearance for motels, hotels, swimming pools, patios, walks and driveways, drive-in restaurants, amusement and public parks.

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L-M's Lawn-Glo lights are distributed exclusively through electrical wholesalers. These attractive lights have non-corrosive aluminum and plastic construction throughout. Post-top models are available with either natural redwood or black metal posts as an accessory. Photocontrol available, automatically turns lights on at dusk and off at dawn.

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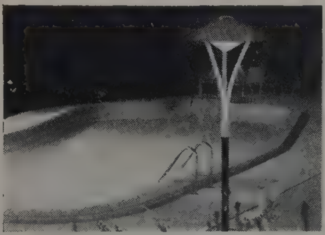
"Lawn-Glo" is a Line Material trademark.

Lawn-Glo Style A luminaires shown at right provide lighting for this swimming pool. These Lawn-Glo lights are ideal for homes as well as motels, restaurants, drive-ins, parks All the light is directed down—it does not escape to annoy neighbors.



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Today's office interiors depend on *color* for their striking modern beauty. And to get the full effect of true color harmonies, lighting must be evenly diffused over all areas. Here, in Union Carbide's new Park Avenue building, panels of Bakelite Brand rigid vinyl sheets provide the ideal illumination to enhance the unusually colorful furnishings and wall treatment.

Today, you can get Bakelite rigid vinyl sheets that are practically immune to the cracking that raises the cost of installing and maintaining continuous lighted ceilings. That's because these sheets are formulated and fabricated especially for light diffusion. They are expected to last for years without yellowing in standard installations.

They're self-extinguishing, but the installation can be designed so they'll soften and fall out before the sprinkler operating temperature. Installing them with baffles or laminating with special sound-deadening material gives them good acoustical properties. Costs can be cut because much thinner sheets can be used than for other types of diffusers.

There are many other things to look for in Bakelite rigid sheets for continuous lighted and luminous ceilings. If you're not getting them all, write for facts, literature and a list of suppliers, Dept. FE-41, Union Carbide Plastics Company, Division of Union Carbide Corporation, 270 Park Avenue, New York 17, N. Y. *In Canada:* Union Carbide Canada Ltd., Toronto, Ont.

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UNION CARBIDE

COLOR-BALANCED LIGHTING

(*Continued from* 109)

A PROBLEM that has long been faced by artists, editors, photogravure technicians and others who are involved in full-color printing, has been one of communication. In other words, the problem has been one of being sure that each person viewing a color transparency, for example, would see the exact same colors. The same problem has also existed with respect to original art work in color, or color proofs, and eventually final press results.

This problem has now been solved, or at least greatly reduced. The solution is the adoption of *standardized* lighting, so that each person or technician who views the transparency or other color art work sees the object under the same conditions and color quality of light.

The first major installation of standardized lighting for color work has been made by Time, Inc., publishers of *Time, Life, Fortune, Sports Illustrated,* and other magazines in which full-color printing is featured. This standardized lighting system for color processing and printing, installed in areas of the new Time and Life Building in New York where critical color judgment is involved, embraces three separate elements. First, a transparency illuminator was designed and adopted which provides a color-balanced illumination of approximately 3800°K color temperature. Second, light sources having the same spectral energy distribution as those used in the illuminators were adopted for use in the luminaires which provide general room illumination. Third, a neutral "cotton grading gray" paint, which matches a Munsell Gray Scale Patch N8-½, was selected for use on the side walls and all interior reflecting surfaces.

These three elements were adopted for the color processing laboratories, and in other areas where original art work in color, page and press proofs, and final printed results, are viewed and judged. In such areas, all daylight is excluded. In addition, the standardized transparency illuminators are provided for art editors and others, for use in their own offices where other types of general lighting, and even daylight, may be present.

The transparency illuminators consist of a metal housing, a white plastic diffusing panel, a paracyl reflector, and two 30-watt rapid start fluorescent lamps. The housings are made for various methods of mounting. The diffuser panel is Plexiglas W-2447 white acrylic plastic, selected for its color purity and lack of color distortion. The light sources are Philips series "TL" fluorescent lamps, 30 watts each, color 34 (Norelco type F30 T12/34/RS). The illuminators were designed and made by Ideax Corp., New York City.

The success of this installation, according to Time, Inc. technicians, is the result of the selection, adoption, and standardization of a specific light source, with a median color temperature and good color balance, which permits critical color viewing and judging, from one location to another, under identical lighting conditions.

COLOR IN LIGHTING

(*Continued from* 109)

THE use of color in lighting ranges widely, from ordinary, everyday esthetic and decorative applications, to the highly scientific and technical applications. An excellent example of the scientific and technical uses of color in lighting is demonstrated by the many light chambers, translucent light units, photometers and devices in use in the Color Laboratory of Rohm & Haas Co., Bristol, Pa.

This Color Laboratory has three main responsibilities—basic research, quality control, and customer service—as it relates to their plastic products, Plexiglas and Implex. Some of these instruments and devices, and their use as related to color in lighting, are illustrated and discussed here.

The expanding use of colored plastics, especially in lighted signs, has resulted in an increasing number of requests for the matching of colors. Originally, color matching was a trial and error procedure, involving days of work. Colorants were mixed, and sample plastic sheets were cast, over and over, until a product color was obtained which matched a customer's sample. This work is now done by electronic equipment, and the color matching is done in minutes instead of days, and the results are far more precise.

In color matching by instruments, the color sample is first analyzed by a special spectrophotometer. The photometric information is then fed into an analog computer, along with the characteristics of the colorants which could be used to produce the exact color desired. The exact formulation needed is computed by the machine. Color differences so subtle that the eye cannot detect them are readily measured on this instrument.

Visual evaluation is also important, since in actual use the colored plastic will be viewed by the human, rather than the electronic, eye. Visual checking is thus also done, under standardized conditions. For this purpose, super skylights and a Macbeth light chamber, are used. In these areas, the lighting is standardized. Two sets of filament lamps are used. One set of lamps is covered by special blue glass filters to simulate north sky daylight. The other set provides conventional tungsten lighting. The lamps are operated at precisely controlled voltage so that the filament temperature of the lamps—and the resulting wavelength of the light emitted—is always the same. A visual color match that survives examination under both illuminants may be assumed satisfactory for almost any lighting condition.

COLOR of test sheets of Plexiglas is checked visually under the standardized lighting of a Macbeth light chamber, in which either simulated daylight from the north sky, or conventional tungsten lighting, may be used.

3-D REALISM IN MURAL

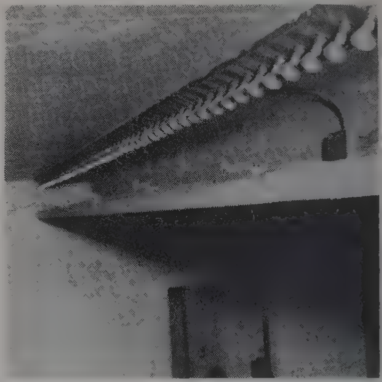
(Continued from 109)

LIGHTING is used to enhance, and to further dramatize, the three-dimensional effect and illusion of realism in an unusual mural in New York City. This mural occupies an entire 44-ft long wall in the reception area for the new offices of Bourjois, Inc., manufacturers of "Evening in Paris" perfume. The mural, which features a typically Gallic scene of the River Seine, was created by the renowned French painter, Bernard Lamotte, to set a dramatic stage for Bourjois visitors as they enter the reception area.

The lighting for this mural was specially designed to provide a wide range of illumination levels on the mural, of uniform intensity at all levels, and of a suitable color quality to accent the warm rays of a setting sun, or the brilliance of noon sunlight. The lighting was installed before the mural was painted, and the work was then carried out under the illumination which would be used to light it.

The lighting equipment is concealed in the ceiling, in a typical reverse cove. It consists of a continuous row of 20-watt type R12 reflector spot lamps, spaced 5 in. on centers, and 8-watt F8T5 soft white fluorescent lamps, spaced 36 in. on centers. The reflector lamps are angled slightly, so that the center of each beam of light strikes the mural about 36 in. above the floor. Since the light distribution is of the concentrated type beam, the upper part of the mural is lighted by the low candlepower part of the beam, and uniform lighting results.

The reflector lamps are rated at 28 volts, and operate from a 120/28-volt transformer. They are dimmer-controlled from full brightness to blackout. The fluorescent lamps operate at full intensity at all times, from a 120-volt circuit. Thus, as the incandescent lamps are dimmed, to simulate the coming of night, the color quality of this light becomes more yellow, and the soft white fluorescent lamps add a subtle warm pink glow. The effect is dramatic, and startlingly realistic. The lighting was designed by Thomas Smith Kelly, lighting consultant.



CONCEALED in reverse cove at top of mural is the lighting equipment which provides uniform lighting over the entire wall area. Equipment consists of 20-watt R12 reflector lamps in special wireway housing, and 8-watt F8T5/SW fluorescent lamps on standard wireway. Reflector lamps are 28-volt type, and dimmer-controlled.

● LIGHTING FOR DECORATION

MULTI-COLOR LIGHTING

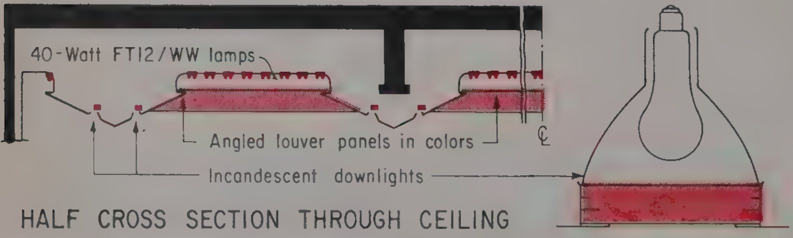
(Continued from 109)

LIGHTING serves a dual role in the Canadian Room of the Royal York Hotel, in Toronto, Ont., Canada. It provides general illumination ranging in lighting levels from dim-out to 65 footcandles, and varying in spectral quality over a wide range. This flexibility, in both quantity and in color quality of light, provides individual and specific desired lighting results for each of the variety of functions for which this room is used—exhibitions, dances, TV presentations, banquets, etc.

This auditorium is a huge area, 180 ft long, 80 ft wide, and 28 ft high, with a spacious balcony at one end of the room. Its decor features Canadian materials and motifs. A lighting design requirement was that wood panelings and carefully chosen materials be displayed without color distortion. A further requirement was that the lighting should implement changes in the decorative treatments to harmonize with different events. Thus, the lighting had to be designed as an integral part of the decorative treatment.

A number of lighting features were developed for this auditorium. These included a three-colored translighted ceiling, an incandescent direct downlighting system for general illumination, cove lighting with cold cathode tubing above and under the balcony, reflector lamps installed at top and bottom of wall areas, angled reflector lamp units to light a relief mural of Canada, back-lighted translucent panels in the face of the balcony front, and special lighting from the ceiling for the dais area. All lighting elements are on separate dimmer controls, which permit full flexibility of lighting effects as may be required, or desired. Combinations of adjusted lighting levels for different areas provide a wide range of environmental effects.

One of the most striking features of the room is the ceiling. It is an intricate lighting element capable


40-Watt FT12/WW lamps
Angled louver panels in colors
℄
Incandescent downlights
HALF CROSS SECTION THROUGH CEILING

DETAILS of the ceiling lighting systems are shown in this drawing. Either the fluorescent or the incandescent lighting system can be used individually to light the auditorium, or both systems may be used simultaneously. Color quality remains constant at all levels of illumination, but colors of louver panels vary widely at different lighting levels. Color louvers for the incandescent downlights are interchangeable, and colors appropriate for the various special events may be used.

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Below: *Harold A. Glass, Executive Vice-President of Lighting Products Inc., Highland Park, Illinois.*

Above: *Installation of Sola ballasts in LPI fluorescent luminaire helps assure peak performance and reliability.*

A fixture manufacturer talks about Sola ballasts and Sola's in-warranty replacement plan—

"Sola ballasts in LPI fixtures have proved 99.53% reliable"

"Detailed records on a typical sample lot of 19,000 Sola ballasts installed in LPI fixtures show these ballasts are 99.53% reliable," states Harold A. Glass, Executive Vice-President of Lighting Products Inc. "This low failure ratio of less than one-half of 1% is excellent for this type of equipment.

"With Sola ballasts, our fixtures deliver the performance we've engineered into them . . . thus guarding our reputation as a manufacturer of high-quality industrial and commercial fluorescent lighting products. Reliable operation of Sola ballasts in our fixtures means more satisfied customers, from wholesaler to contractor to user. We like the way Sola's in-warranty replacement plan works to eliminate any inconvenience for us in the rare instance of an in-warranty ballast failure. It assures speedy replacement that helps the customer, too."

Mr. Glass is one of many fixture manufacturers who benefit from the superior performance and reliability of Sola ballasts — reliability that makes possible Sola's unusual in-warranty replacement plan. This plan enables wholesalers to provide a replacement — *at full profit* — for any Sola ballast which may fail within warranty. If the wholesaler does not stock Sola ballasts, he will provide an equivalent certified CBM ballast of another make. This replacement service is provided by 354 qualified wholesalers located throughout the United States.

Full light output, quiet operation, cool in-fixture performance, full-rated lamp and ballast life that means excellent operation — these are some of the advantages that are offered by Sola ballasts and that have been proved by tests under the most severe operating conditions. *For full information on Sola ballasts, write or call your nearest Sola representative.*

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of numerous effects, and a colorful decorative feature. It contains both fluorescent and incandescent lighting, separately controlled. Fluorescent lamps are concealed above angled surfaces made up of triangular and diamond-shaped honeycomb anodized aluminum panels, finished in gold, blue and silver. Incandescent reflector downlights are recessed vertically in angled plaster surfaces, spaced properly to provide uniform lighting over the entire floor area.

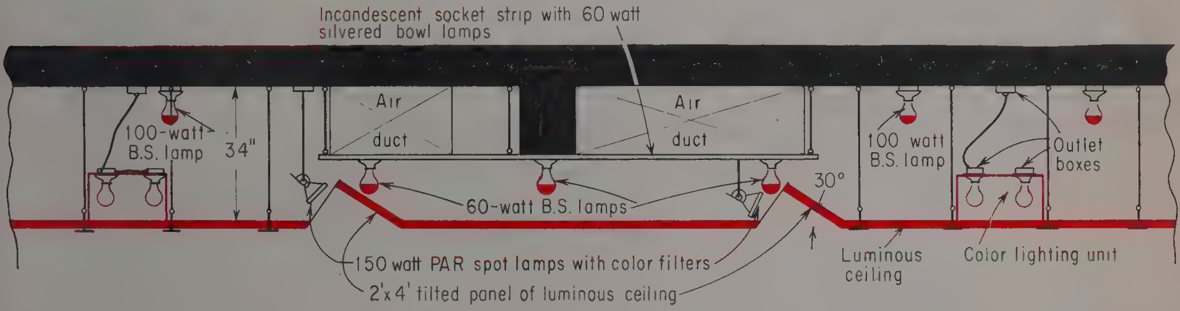
The recessed ceiling downlights contribute to the decorative treatment of the room without affecting the functional quality of the lighting. The colored louver assembly in each downlight allows the louvers to be viewed in color, while the reflected and direct light from the lamp comes through the unit's aperture as white light. There are 94 300-watt units with gold louvers, and 98 200-watt units with green louvers.

The proportions and overall lighting levels from both ceiling systems of lighting can be varied, and uniform floor coverage can be obtained by either type of lighting. Under all combinations, the color rendition of the wood paneling, carvings and special draperies remains constant.

The firm of Ross, Fish, Duchenes and Barrett of Montreal, served as architect for this project, and also was responsible for interior decoration and design. James Keith & Partners were the engineers. Rollo Gillespie Williams, director of Color Research for Century Lighting, Inc., was the consultant for lighting design.

VARIABLE ENVIRONMENTS

(*Continued from* 110)


Incandescent socket strip with 60 watt silvered bowl lamps
Air duct
Air duct
100-watt B.S. lamp
34"
100 watt B.S. lamp
Outlet boxes
30°
60-watt B.S. lamps
150 watt PAR spot lamps with color filters
2'x4' tilted panel of luminous ceiling
Luminous ceiling
Color lighting unit

CROSS-SECTION through part of ceiling shows details of luminous ceiling lighting, color boxes, and stage lighting border lights. Ceiling air ducts and beams are white, and bowl-silvered lamps indirectly light the aluminum louvers.

LIGHTING provides the key to variable environments for a wide range of social functions and club activities of American Legion Post No. 5, Pittsburgh, Pa., in their recently remodeled club rooms. The lighting, which is integrated with the architectural design and structural details, literally sets the stage for lectures, meetings, banquets, dancing, stage entertainment, and other such activities. It was planned, and built into the interior design as part of the remodeling of the club rooms.

In remodeling, a conglomeration of air diffuser ducts and openings, structural beams, and the old ceiling tile were concealed by means of a new luminous ceiling suspended 34 in. below the original ceiling. For this purpose, an aluminum honeycomb louver, with 45° by 45° shielding, was selected. This louver panel ceiling, supported on inverted T-bars, permits free passage of conditioned air to the club room area below, has sound absorbing qualities, is extremely low in brightness when lighted to maximum intensity, and is efficient in light transmission.

A total of 78 100-watt bowl-silvered lamps, and 41 60-watt bowl-silvered lamps, were installed above the louver panels to provide the basic general illumination for the area. The entire plenum cavity was finished flat white, and the 100-watt lamps were installed on the old ceiling while the 60-watt lamps were installed under beams and air ducts. By means of dimmer control, an average illumination level of 30 foot-candles maximum is available, or any lower lighting level down to blackout.

Color in lighting was added as a purely decorative treatment. A total of 31 color lighting boxes was installed in the luminous ceiling in a random pattern. Each color lighting unit is 2 ft sq by 9 in. deep, finished flat white inside, and equipped with three porcelain sockets for three 75-watt lamps—one each red, green and blue. The face of this lighting unit contains a panel of the same type of aluminum louver material as the luminous ceiling. Each lamp socket is on a separate dimmer circuit, so that either the red, the green or the blue lamps can be individually controlled and dimmed. This arrangement provides a limitless number of color effects and changes in the decorative environment.

As a separate decorative lighting feature, deep-recessed adjustable colored floodlamps are spaced and positioned in the ceiling adjacent to the walls, to provide a decorative color "wash" on the wall.

Another lighting treatment was installed to light an electrically operated "roll out" stage, for any stage position. Three rows of 150-watt red, clear and blue projector lamps in adjustable housings were installed at carefully selected concealed positions in the ceiling. At these locations, a continuous section of the luminous ceiling material can be raised to a 30° angle, to allow the spot beams to light the stage.

As designed and installed, this lighting is a dynamic, colorful and dramatic medium, creating an enjoyable and pleasing environment, and setting ever-changing, appealing moods suitable for any of the social and entertainment functions planned and held by American Legion Post No. 5.

This lighting installation was planned by Charles Roberts, architect, in consultation and cooperation with Armand G. Zitelli, illuminating engineer, Duquesne Light Company, and installed by Kurt Alexander, electrical contractor.

IMPROVE LIGHTING QUALITY

(*Continued from* 110)

COLOR in lighting serves a dual role in Barton's Bonbonnière, a New York City candy store. It adds a decorative touch to the interior in the lighting system, and also lightly tints the general illumination in the store. This is one of several stores in this chain that is lighted in the same manner, which also serves as a symbol of identification.

The lighting system provides a high level of 200 footcandles of illumination throughout the store. It consists of continuous rows of Power Groove fluorescent lamps in metal housings, spaced 24 in. apart and suspended 18 in. below the ceiling overhead, and equipped with translucent plastic egg crate-type louvers to form a luminous ceiling over the entire store. Louvers under the lamp compartments are white, and louvers which lay in between the compartments are a pastel yellow. Light from the lamps passes both directly downward to the display areas and upward to the white plenum ceiling, where it is indirectly reflected and diffused downward through the yellow plastic louvers to the displays.

The major percentage of illumination reaching the display areas is direct from the "Cool White" fluorescent lamps, through the white plastic louver panels below the lamp compartments. The indirect lighting component, which is diffusely reflected from the white plenum ceiling is partially white light, for that part coming through the louver openings, and partially tinted, for that part being transmitted and diffused through the yellow louver fins. These yellow louvers literally "come alive" with light, and add a distinctive decorative effect. The addition of the yellow light from the louver fins to the general white illumination, merely provides a slight yellow-orange tint which accents the chocolate candies and packaging.

EXPAND DECORATIVE EFFECTS

(*Continued from* 110)

LIGHT attracts attention, and color lighting increases the attraction value of light. Thus window display decorators have long made use of color lighting in show windows. The color picture showing a Higbee Co. show window in Cleveland is a typical example.

A basic color-in-lighting principle was used in the lighting of this window display. This principle is the use of two complementary colors, of approximately equal intensity for each color, to produce white light on surfaces where both colors fall and blend together. In the Higbee display, one 150-watt amber light is located overhead on one side of the feature of the display, and three 150-watt blue lights are located overhead on the other side of the model being lighted. On surfaces where both amber and blue light fall, the color quality of the light is approximately white. Background shadows behind the model, from the blue lights, are lighted directly by the amber light, and shadows from the amber lighting are likewise lighted directly by the blue light. This technique thus provides white light on the display feature, and a colorful and decorative background lighting effect.

Many artistic and dramatic decorative lighting effects are possible through the use of two or more colors of light; and when lamps are carefully located with respect to objects, to throw preconceived and preplanned shadow shapes and patterns, unusual artistic and dramatic color lighting effects can be obtained. Typical applications for such color lighting techniques include display areas, reception rooms, restaurants, cafeterias, night clubs, lounges, flower shops, etc.

GARDEN LIGHTING

(*Continued from* 110)

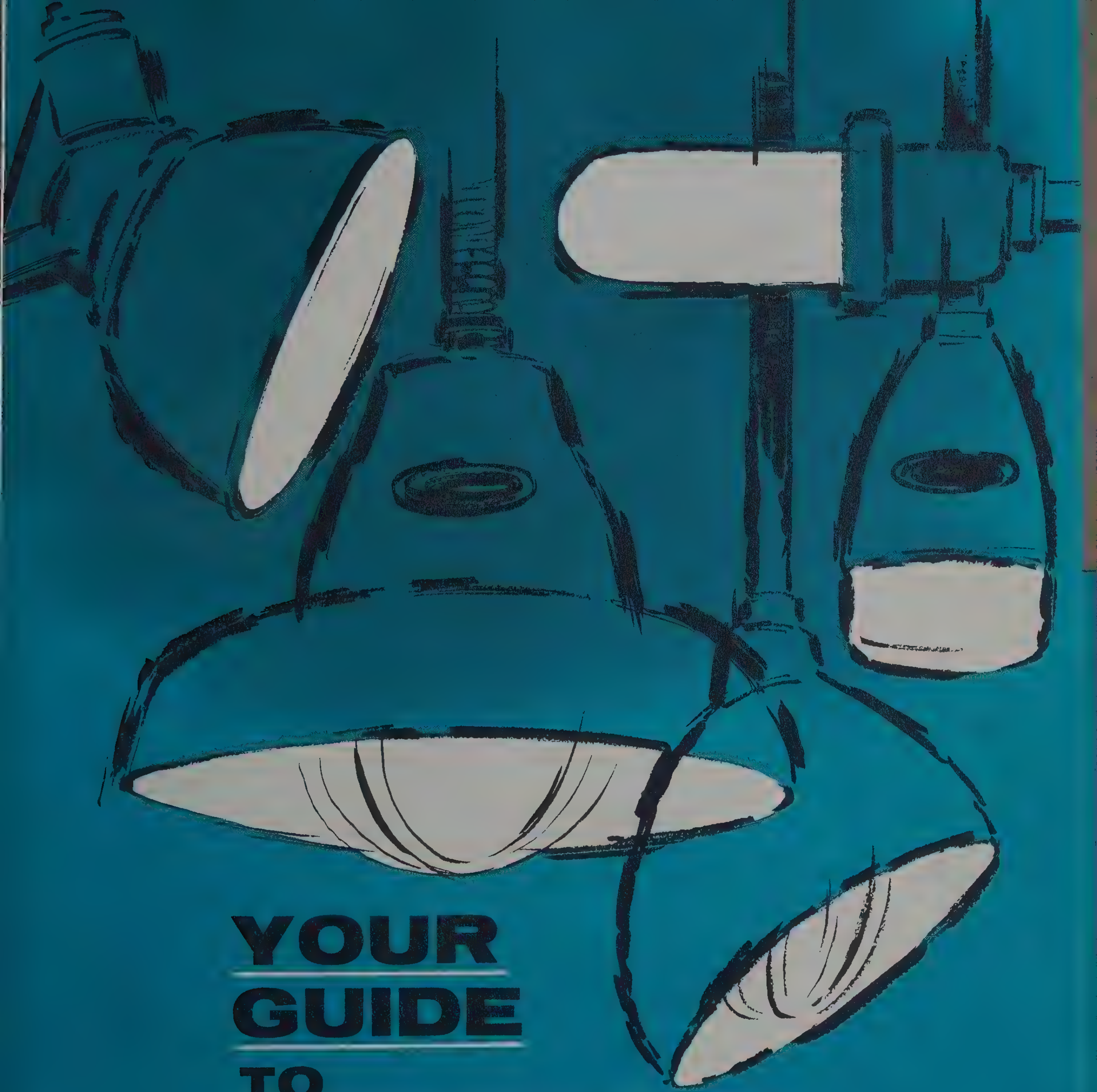
MORE and more contemporary homes are designed with provisions for outdoor living. The usefulness of this feature can be expanded if the outdoor areas for such homes are well lighted so that they can be used at night. Also, many homes have vistas from living or dining room windows, patios, etc., of gardens, lawns, and nearby areas, which can be transformed into colorful and dramatic night scenes by the addition of lighting.

Garden lighting is often highly effective when done with white light only. The lighting of flowers, for example, reflects a riot of color under white light, since nature has already added the color. Color lighting is also useful, and many applications can be found for the use of color lighting as a decorative treatment. White walls, trellises, statuary and foliage take on an added beauty when lighted with pale tints of amber, green, or blue-green. And the foliage of trees and shrubs is greatly enhanced by light from non-color-corrected mercury lamps. Fountains, pools and rock gardens all take on new beauty at night when lighted with appropriate tints and hues of color lighting.

Over the past few years a variety of lighting devices have been developed and made generally available, both for permanent and temporary garden lighting applications. These range from decorative metal shield cutouts which shield the lamps, to metal reflector and projector lamp flood and spot units, to lily-pad lights, to mushroom-type units, and other similar units. Color lighting effects can be obtained either by using tinted or colored lamp bulbs, or by using glass color roundels which fit over the reflector lamps and floodlight units.

Another approach to color lighting in garden areas is to use ultraviolet radiation, or "black light" units. The water in cascade pools, for example, can be treated so that it fluoresces under black light radiation; and rocks, foliage, etc., can also be treated with fluorescent dyes and pigments for unusual color lighting effects under this type of lighting.

In general, color lighting effects are most effective when used in areas of darkness, or very low lighting levels. Also, it is advisable not to try to floodlight the entire garden. Use of several lighting units is preferred, separated from each other, so that there will be a contrast of highlights and shadows.



YOUR GUIDE TO CROUSE HINDS LIGHTING PRODUCTS

- INDUSTRIAL
- COMMERCIAL
- SPECIAL-PURPOSE

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- *Fluorescent*
- *Mercury Vapor*

IN EVERY TYPE OF CONSTRUCTION:

- *Explosion-Proof*
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FOR EVERY POSSIBLE APPLICATION:

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- *Area*
- *Flood*
- *Stationary*
- *Portable*

To locate exactly the right fixture or floodlight for any specific application, consult the "Applications Guide to Crouse-Hinds Lighting" on the opposite page. From this chart, you will find the Crouse-Hinds Catalog Section which will supply you with details on the variety of items suitable for your application. See your Crouse-Hinds Distributor for further information and prices.

on't Settle for "Almost". It is possible to answer lighting problem with equipment that is "almost xactly" what is needed.

It is also possible — and a great deal more satisctory and less costly — to meet it with exactly e right equipment.

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APPLICATIONS GUIDE TO CROUSE/HINDS LIGHTING

Product	Range	Bulletin or Catalog Section
HAZARDOUS LOCATIONS (Explosion-Proof and Dust-Ignition-Proof)		
Lighting Fixtures	Incandescent, Fluorescent, Mercury Vapor	Sec. KE, KM, Catalog 3000; Bull. 2722
Portable Work Lamps	Incandescent	Sec. KH, Catalog 3000
Floodlights—Stationary and Portable	Incandescent	Sec. 205, Bull. 2714
Gas Station Lighting—Stationary and Portable	Incandescent, Mercury Vapor	Bull. 2704
Gauge Lights; Pilot Lights; Tank and Observation Lights	Incandescent	Sec. KM, P, & R, Catalog 3000
NON-HAZARDOUS LOCATIONS		
Lighting for Damp, Corrosive Conditions	Incandescent	Sec. KV, Catalog 3000; Bull. 2699
Gauge Lights; Pilot Lights; Tank and Observation Lights	Incandescent	Sec. KM & P. Catalog 3000
Marine Floodlights	Incandescent	Sec. 206, Bull. 2714
Sports and Recreation Lighting: playgrounds, playing fields, courts	Incandescent, Mercury Vapor	Sec. 202, 203, Bull. 2714; Bull. 2721
Protective and Security Lighting	Incandescent, Mercury Vapor	Sec. 201, 202, 203, Bull. 2714
Decorative Exterior Building Lighting	Incandescent, Mercury Vapor	Sec. 201, 202, 203, 204, Bull. 2714
Search, Signal Lights	8″ to 36″ Incandescent	Sec. 206, Bull. 2714
Tunnels, Viaducts, Underpasses, Roadways	Incandescent, Fluorescent	Sec. 204, Bull. 2714
Area Floodlights: docks, parking lots, yards, construction sites, etc.	Incandescent, Mercury Vapor	Sec. 201, 202, 203, Bull. 2714; and Bull. 2719
Underwater Lighting: swimming pools; rescue, salvage, search, constr.	Incandescent, Mercury Vapor	Sec. 207, Bull. 2714
High Bay Lighting	Mercury Vapor	Sec. 204, Bull. 2714

WITH CROUSE/HINDS PRODUCTS

"Relamping was difficult and costly in the high bays of our Plant." The answer: Crouse-Hinds Mercury Vapor Lighting Fixtures giving up to ten times longer lamp life than incandescents. Power costs were cut, too. Mercury vapor light output is 2.5 times greater than incandescents. The savings in this case more than paid for the extra initial cost of mercury vapor fixtures within a year.

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"We'll need some hand lamps for use in hazardous areas . . . but where do we find some that don't weigh about a ton apiece?" Crouse-Hinds Type EVH explosion-proof hand lamp weighs just 4¼ pounds—less than half the weight of previous lamps of its type, and smaller in size. This has been accomplished at no sacrifice in safety or resistance to rough usage.

"We're proud of our new building. How can we arrange the best decorative lighting at night?" The choice of arrangements with Crouse-Hinds Floodlights is enormous, using combinations of plain, smooth or diffusing lenses, or lenses with medium or wide horizontal or vertical spreads . . . glass of four basic colors (or clear) . . . a range of intensities from 200-2000 watts.

"What's the best way to light two miles of fence" In most cases it's desirable to light not only the fence, but also a broad area on either side. This is best accomplished with the Crouse-Hinds PLB Fresnel Floodlight—a projector with a wide horizontal and narrow vertical beam spread. Properly spaced PLB's give bright, continuous security lighting the full length of the fence.

"There's more than a mile of tunnel to light on this project, so we're looking hard at costs." The higher efficiency and longer life of fluorescents are preferred in such applications. Crouse-Hinds HLG Fluorescent Fixtures for tunnels and underpasses can be mounted in continuous rows. When mounted on the ceiling, their wide distribution provides some light on ceiling.

CROUSE HINDS
SYRACUSE NEW YORK

Call on your Crouse-Hinds Distributor for complete information on any or all lighting fixtures, components, ratings, applications, etc. For especially knotty application problems he will see that you have the assistance of an experienced Crouse-Hinds Field Representative.

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Epoxy Jackets Protect Motor Coils

How rewound motors are protected by epoxy encapsulation which resists the attacks of corrosive atmosphere and prolongs motor life.

A SUBSTANTIAL saving running into the thousands of dollars annually has been realized by Pittsburgh Coke and Chemical Company in the maintenance of just 15 motors, which move coke conveyor belts and actuate chemical water pumps for this major producer of coke and industrial chemicals. The motors, ranging in size from 3 to 60 hp and including both the totally enclosed fan-cooled and explosion-proof types, are subject to high moisture, intense dust, and chemical contamination in their operation.

According to Walter T. Wright, chief electrician for the company, the difficult operating conditions were "grounding" the windings and causing the motors to "blow up" in short operating periods. An example is a 5-hp Class-B-insulated motor (Fig. 1), which is located in a partially enclosed structure above the conveyor belt that moves freshly quenched coke from the coke production plant to the storage bins. Steam condensation was causing intense moisture concentration in the confined area, which also is subjected to coke dust. Under these conditions, the motor failed frequently and it was necessary to remove it for rewinding. This cost the company not only the expense of rewinding the motor, but also the time of several men who were required to remove the motor from its restricted quarters. An additional expense was the downtime experienced until a substitute motor could be installed.

To solve the problem, a solvent-

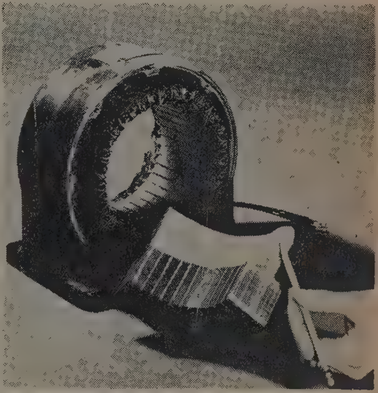


FIG. 2—Epoxy encapsulation of winding completely fills the interstices in the ends of the windings, locking out all foreign matter that might cause motor failure, providing complete protection against dust and chemical deposits.

FIG. 1—This 5-hp motor driving a conveyor belt section has epoxy encapsulated windings to protect against destructive effects of steam condensation and coke-dust accumulations.

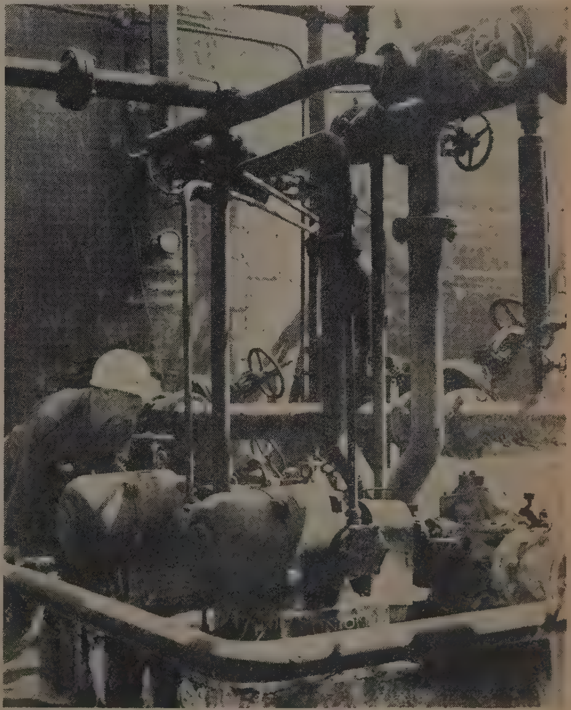
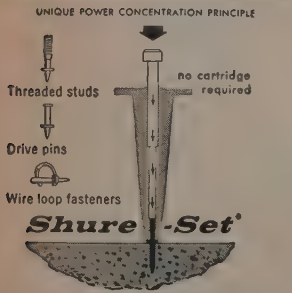


FIG. 3—Outdoor motors used to drive chemical and water pumps are protected by epoxy from the effects of moisture and the fumes from caustic coal tar acids.



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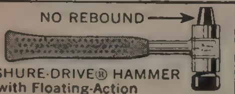
Your Shure-Set dealer is listed under "Tools" in the Yellow Pages. Call him or write us direct for complete information.



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less epoxy protective encapsulation was applied after rewinding. Designed for "problem" motors which must operate in high humidity or chemical-laden atmospheres in many different industries, the epoxy, known as "Super Coilife," has low viscosity which enables it completely to penetrate the interstices of the windings, as well as the slots. The epoxy material is applied by a process that utilizes the correct "thin-wall" thickness for each type and class of winding. It provides complete encapsulation of the windings (Fig. 2), locking out all foreign matter that might cause serious grounds and the motor to fail. Because of extremely high flexibility that leaves the epoxy encapsulation unaffected by differential expansion and contraction, the mirror-like finish will not crack or craze in severe operating temperatures and other conditions.

The Pittsburgh Coke and Chemical motor that formerly failed with frequent regularity continued in operation on the 40-ft section of quenched coke conveyor for an uninterrupted period of 14 months with the epoxy encapsulation. Mr. Wright reports that the failure then was due to a fuse blowing—resulting in a circuit overload on single-phasing, with consequent burning of the motor windings.

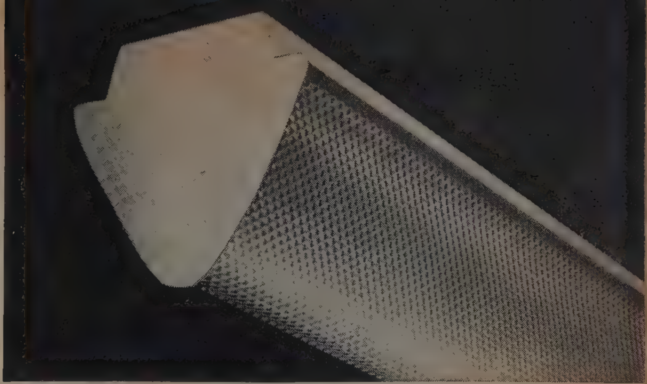
Other motors at this plant are located in open air areas, or in close proximity to chemical pumps and storage tanks (Fig. 3). They are subjected both to high humidity and to caustic coal tar acids, such as phenol. But the epoxy encapsulation safeguards them from such hazards and Pittsburgh Coke and Chemical credits it with "making a big dent" in total maintenance operating costs.

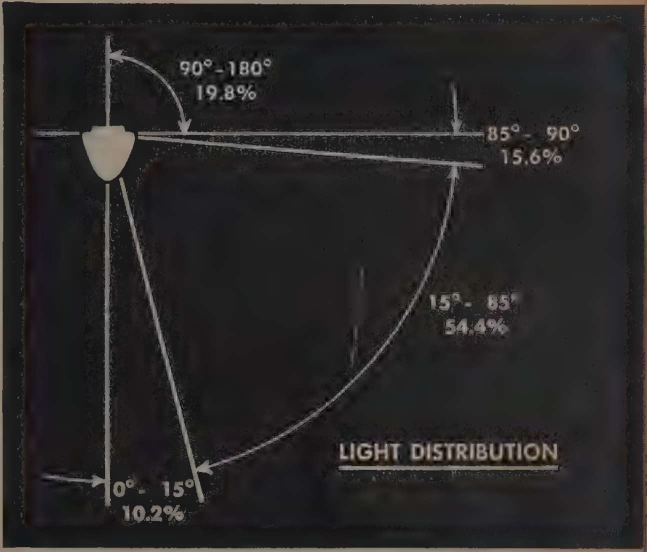
Surface Wiring Expands Plant Distribution

Multi-outlet assemblies were chosen to expand branch-circuit distribution at the Research and Advanced Development Division of Avco Corporation in Wilmington, Mass., made necessary by a significant increase in research work between the planning stage and the date of occupancy.

Two sizes of Plugmold were used (3000 and 2000), the larger as a wall surface raceway with receptacles spotted as needed, and the smaller as a means of providing receptacles on test benches. Bench

ttractive *LPI VeeLens corridor luminaire has V-shaped* *rismatic diffuser and convex reflector which concentrates* *reatest amount of light on wall areas. Viewed endwise, it* *rovides excellent brightness control—maximum brightness* *oes not exceed 350 footlamberts in the 45° to 90° zone.*





Light distribution for LPI VeeLens. Percentage figures show amount of light (based on 100% for half the luminaire) which falls in various sectors. Upward component permits proper brightness ratios and relieves contrast on the corridor ceiling.

New, low-cost LPI VeeLens puts high levels of useful light on corridor walls

he VeeLens fluorescent corridor luminaire is engi-eered for efficient application to school corridors, orary stacks, stock room aisles, and pedestrian nnels. It solves the two important corridor lighting oblems at lowest possible cost: (1) most of the use-l light is directed where you want it—on the ver-cal surfaces, and (2) brightness down the corridor controlled to a comfortable level without glare.

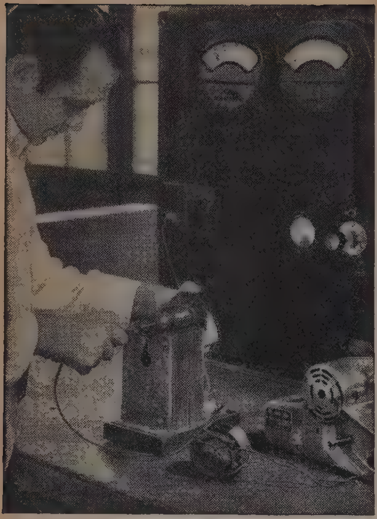
Formerly, only far more expensive fluorescent minaires with intricate shielding, or incandescent minaires with special lenses directed the useful ght so effectively. Now, LPI's VeeLens does the job tter at lower cost because it utilizes a clear pris-atic diffuser containing thousands of 8-sided isms. This diffuser combined with the unit's convex flector distributes useful illumination in the pattern most desirable for corridor lighting—the "butterfly curve." The result is a high level of illumination on the vertical surfaces with controlled brightness when viewing parallel to the luminaire.

VeeLens luminaires are available for surface or pendant mounting, individually or in continuous rows. They utilize one 48" rapid-start lamp in a 4-ft. luminaire, or two 48" rapid-start lamps, tandem, in an 8-ft. luminaire. Diffusers hinge from either side.

For complete information, write for VeeLens bulletin

LPI FLUORESCENT LIGHTING

Lighting Products Inc., Highland Park, Illinois



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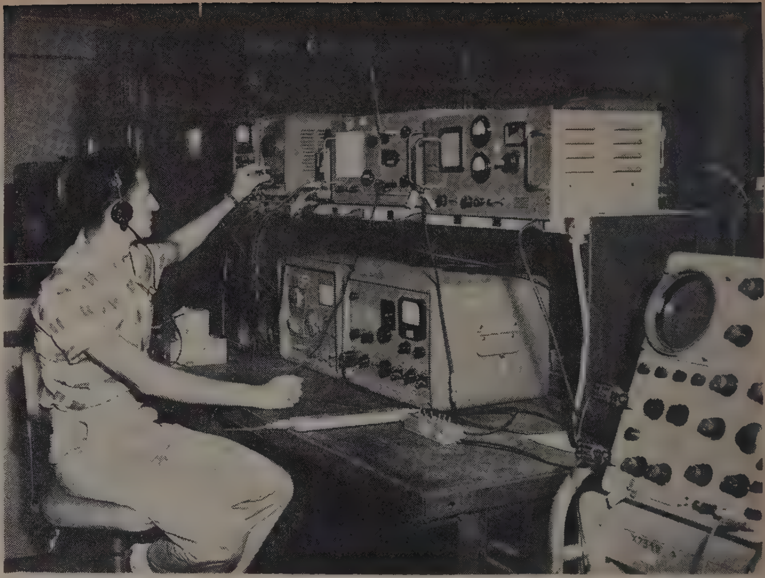


TEST BENCH in electronics laboratory uses multi-outlet assembly as source of power, with receptacles spaced 6 in. apart. Rubber-covered cord at right end plugs into wall outlet to energize bench.

outlets were fed by a 3-conductor rubber-covered cord and cap, which was plugged into a grounding-type wall receptacle. This permits moving of benches as required without disturbing electrical wiring.

Wall-mounted outlets provide 120- and 208-volt single-phase as well as 208-volt, 3-phase power. All receptacles are grounded and polarized as to type of service.

The electrical contractor handling the installation was Manzi Electrical Corp., Lawrence, Mass.

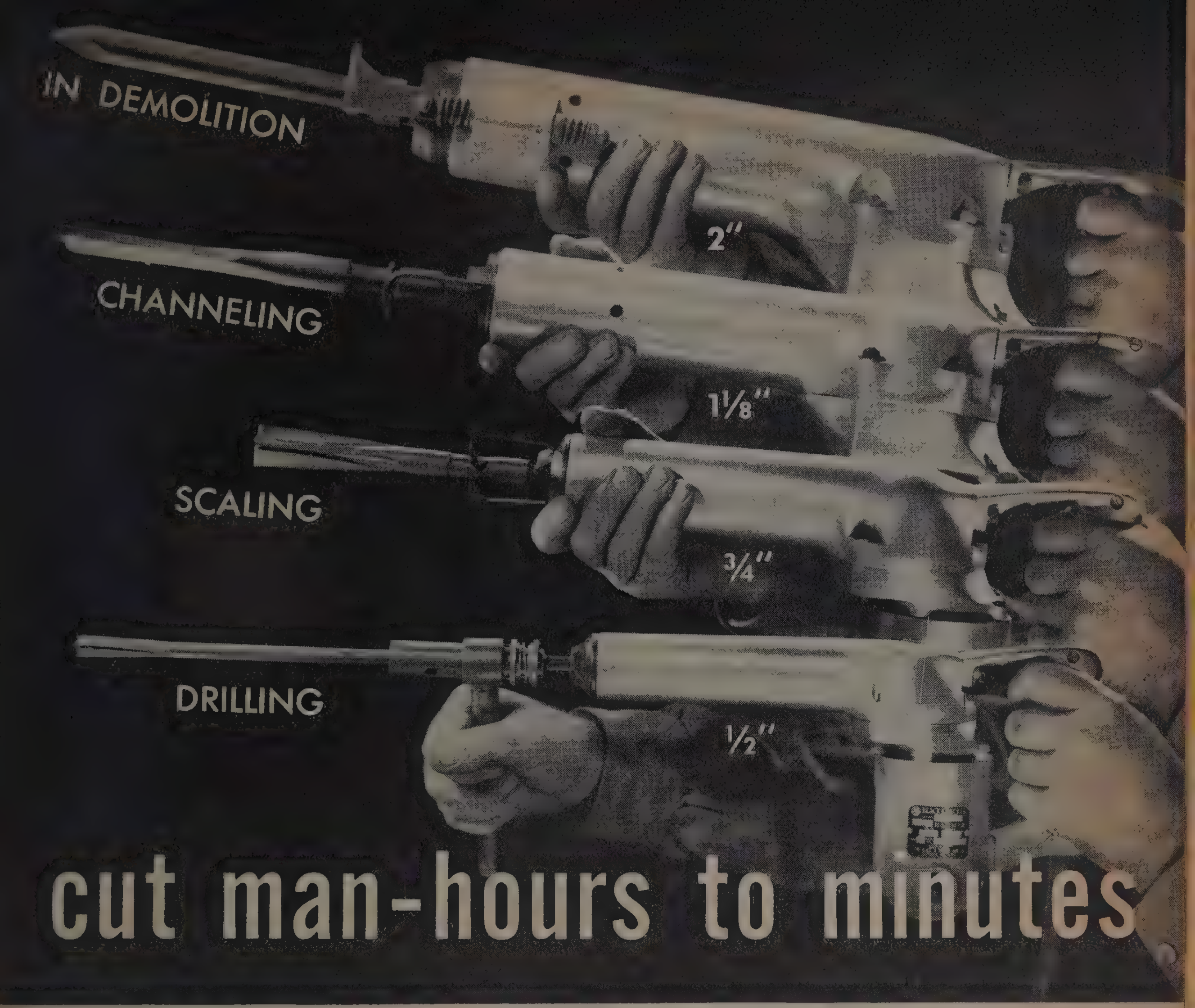
Inclined Rack Simplifies Cable Storage and Measurement

Trucking reels of heavy, expensive, large-diameter high-amperage cables from a storage center to a job-site, then cutting required lengths and returning the reels with unused stock to be replaced in storage will result in (1) double trucking, (2) double handling of reels during removal and replacement, and (3) depletion of that particular-sized cable from the central warehouse while the reel is out on a job. Moreover, carting such reels to construction projects can also result in (4) cables becoming dirty, (5) insulation becoming damaged, or (6) reels becoming "misplaced." And, of course, cutting large-diameter cables on the job calls for at least (7) one more heavy-duty cable cutter. If several reels of a seldom-used cable are kept in stock to preclude such temporary depletion, the investment in this extra slow-moving inventory item will represent (8) extra tied-up capital and (9) extra tied-up storage facilities.

For all of these reasons, electrical contractors Wismer and Becker of Sacramento, Calif., keep large-sized or unusual-construction cables permanently at their main equipment and materials center; storing the reels on steel horizontal spindles which, in turn, are cradled in hooked-ended sockets welded to a large, ruggedly built angle-iron inclined rack, as indicated by the accompanying photo.

Since this rack is positioned at one end of a long smooth-concrete aisle in the shop, and since distances along this aisle are accurately measured and identified by painted numerals it is possible to pull required lengths of cable directly, easily and cleanly from reels, then to cut them for shipment to job-sites. For such local shipping purposes, smaller disposable spools are used, thereby making it unnecessary to keep track of and return those spools to the shop for subsequent return to a cable manufacturer for credit.

Guided by experience, job prints and job-site measurement checks, a foreman can generally order precut cable lengths with a high degree of accuracy, although a small "margin for error" is added to all field measurements to insure an



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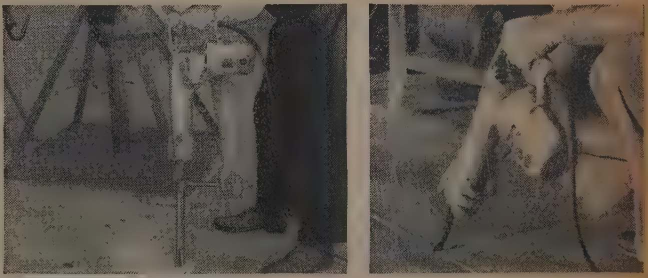

A HAMMER FOR EVERY JOB—a size for every need—that's the B&D Electric Hammer line! Four models give you a choice of ½″, ¾″, 1⅛″ and 2″ drilling capacity in concrete. And power-packed B&D Hammers' many *patented* features put them head and shoulders above the rest.

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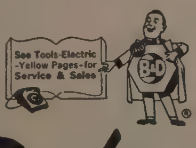

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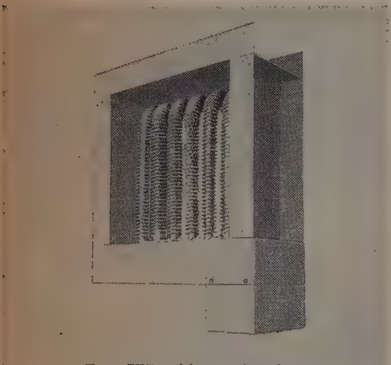
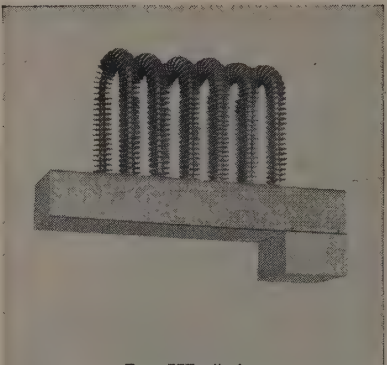
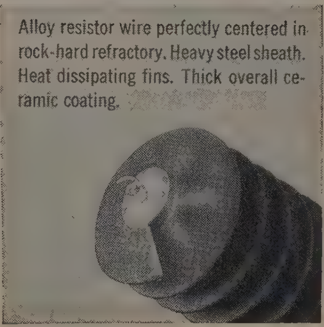


Type FTD, with complete frame.



Type FFT, slip-in.



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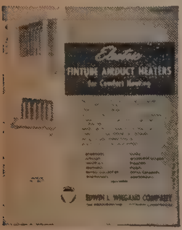

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adequate surplus for terminal connections or the by-passing of minor local obstructions. Although this involves a small, intentional "waste," this practice is more than compensated for by the other savings enumerated above.

Should feeder lengths be for groups of three or four single-conductor cables, rather than for single multiple-conductor lengths, the prescribed number of cables are unreeled, measured and pre-cut at the shop, then they are placed in parallel on the shop floor and wound on disposable shipping spools as coordinated units. Upon arrival at the job-site, they can then be unreeled and pulled into the feeder duct, conduit or raceway in a single operation, again contributing to on-the-job savings in time and effort.

Although handling heavy stock reels in the *field* would constitute a definite lifting problem, the use of smaller disposable spools is not a particularly difficult task. And, since reels stored at the central *shop* can be lifted and shifted easily by means of fork-lift trucks and motorized jib cranes, the procedure herein discussed has Wismer and Becker's complete endorsement as a practical method for simplifying the transfer of large cables from shop to job.

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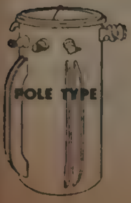

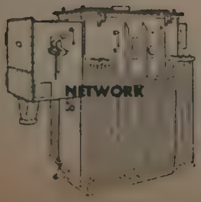

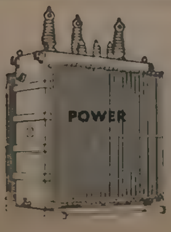

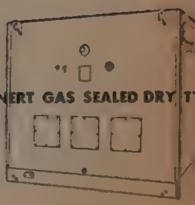
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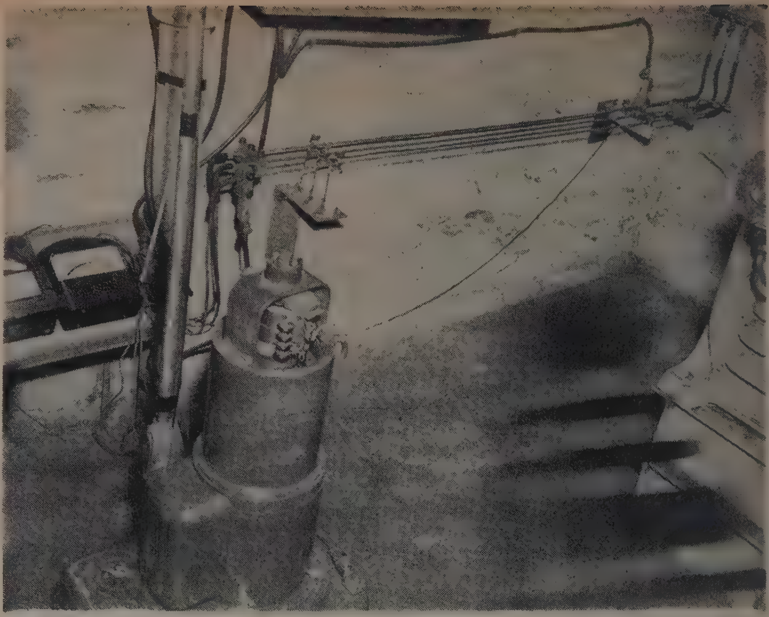

STEEL TUBING provides load for plating generator during brush and commutation tests. Water circulated through tubing carries away generated heat.

Low-Voltage Generator Loading

Brush or commutation testing of high-current, low-voltage plating generators involves finding a convenient, economical way to load the machine which will provide a better means of dissipating the resultant heat than the common prony-brake, dynamometer, resistance-grid, or water-barrel methods.

The method used in the laboratories of the Carbon Products Division, Speer Carbon Co., employs steel tubing in the load circuit to provide the required resistance. With water running through the tubes for cooling, the arrangement is capable of dissipating tremendous amounts of energy in proportion to its physical size. In addition, the system may be easily modified to provide different loads for different generator ratings.

Generator output leads are attached to each end of the tubing as shown in the accompanying photo. In this case, three short lengths of tubing were connected in series to reduce the space required for the setup. Examples of actual installations are 24.5 in. of ½-in. tubing for a 30-kw load on a 21-volt generator and 8.5 in. of ½-in. tubing for a 6-kw load on a 12-volt generator.

Design calculations involve more than just the determination of the tubing length. The expected heat and the volume and velocity of water necessary to remove this heat must be known. In addition, the mean temperature of the tubing must be determined to make sure it won't be prohibitively high.

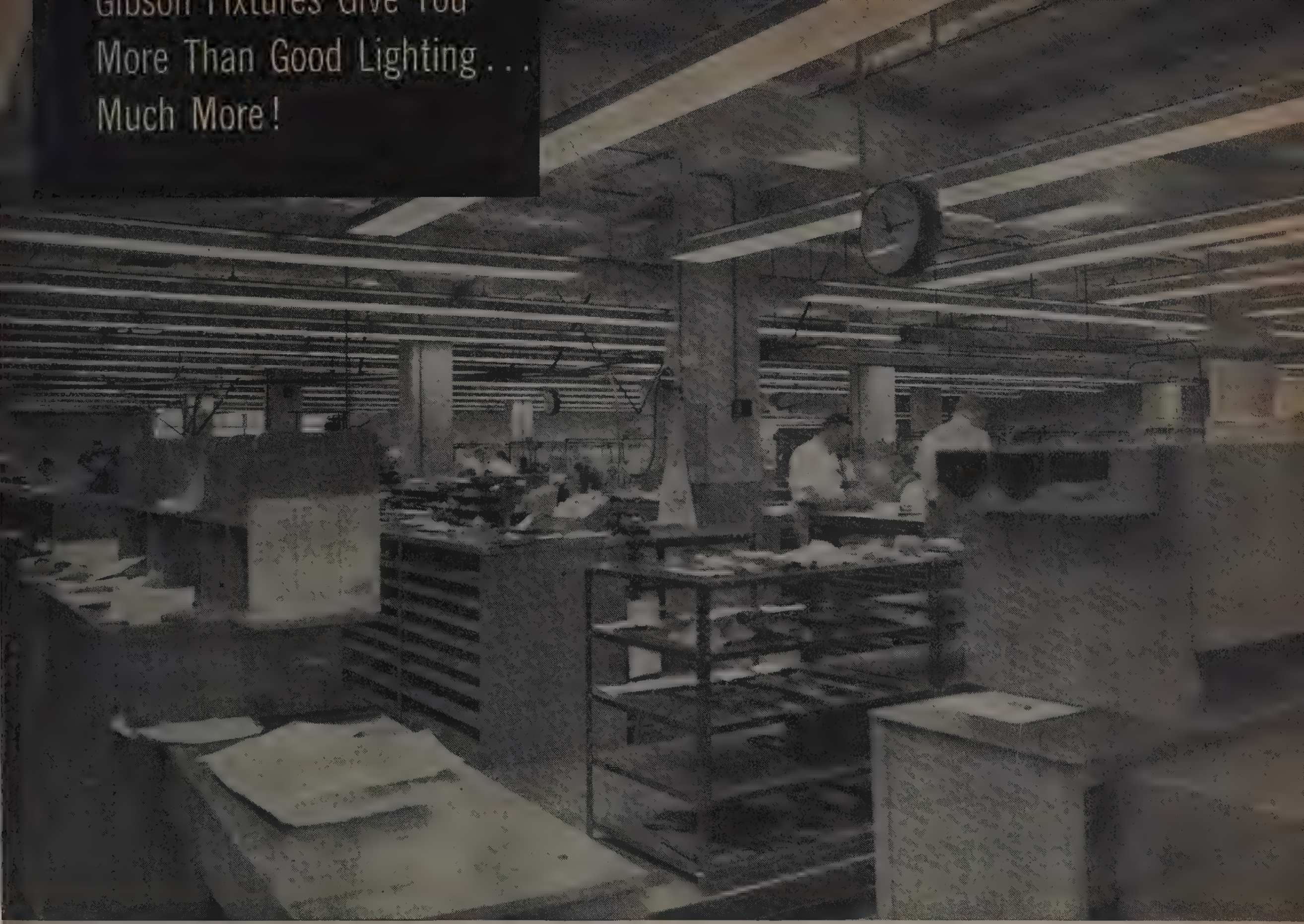
Complete specifications for a typical test are given in the accompanying box; calculating procedures may be found in *Elements of Chemical Engineering*, by Badger and McCabe, McGraw-Hill Book Co., 330 West 42nd St., New York 36, N. Y.

Generator rating:
1000 amps
30 volts
30 kw

Tubing characteristics:
#20 gauge
0.500 in. O. D.
0.430 in. I. D.
Resistivity 0.00003 ohm-in.

Assumptions:
Inlet water temp: 60 F
Outlet water temp: 140 F
Mean water temp: 100 F

Results of calculations:
Length of tubing: 4.25 ft
Heat to be dissipated: 1706 Btu/min
Volume of water required: 0.344 cu ft/min
Velocity of water: 5.75 ft/sec
Head required to produce this velocity: 0.677 lb/sq in. (gauge)
Temperature of tubing: 220 F



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Much More!

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The new Boston Herald Traveler building is lighted throughout with Gibson "plug-in" fixtures. Industrial-type fixtures were used in the mechanical departments and commercial fixtures were installed in the offices. Both types are mounted on the exclusive Gibson Uni-Race. They plug-in like an electric appliance and may be unplugged instantly for servicing, respacing, or replacing any time without tools. More and more important firms are enjoying the economies that this exclusive Gibson feature offers them—lower installation cost, permanence of alignment, and substantial savings in maintenance.

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Clarence Darrow Homes, Chicago Housing Authority, Chicago, Illinois
Architect: L. R. Solomon & Associates, Chicago, Ill.
General Contractor: Sumner-Sollitt Company, Chicago, Ill.
Electrical Contractor: Gerson Electrical Construction Co., Chicago, Ill.

TYING ELECTRUNITE E.M.T. to reinforcing bars is good installation practice. Neat, compact stub alignment is easy when you work with ELECTRUNITE. Full length "GUIDE-LINES" combine with exclusive "INCH-MARKS" for mathematically accurate bends every time. They save time, avoid "wows", eliminate wasted material. Another reason why, "The *Best* Costs *Less* Installed."

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MORE REASONS WHY

THE BEST COSTS LESS INSTALLED

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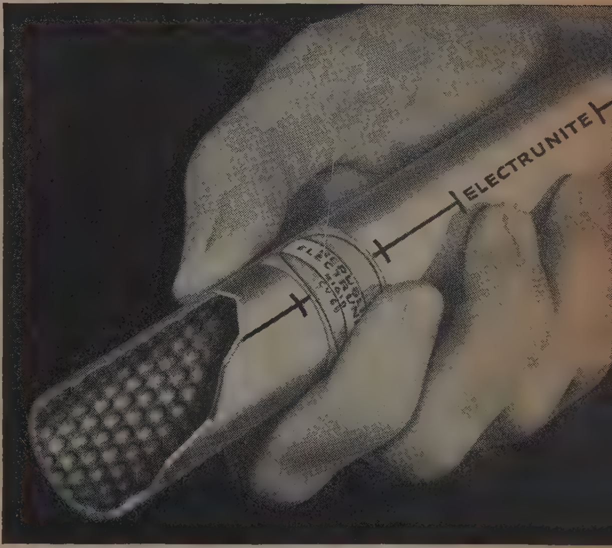
That is why Republic ELECTRUNITE E.M.T. is being installed at more and more big jobs—like the Chicago Housing Authority Job, Project No. 2-36, Clarence Darrow Homes, 38th Street, Langley Avenue and East Pershing Road, Chicago, Illinois.

"INCH-MARKED" in feet and inches for easy, accurate measuring. "GUIDE-LINED" from end-to-end for easy bending. And "INSIDE-KNURLING" with exclusive SILVERSLICK inside finish makes wire-pulling up to 37% easier, wire-pushing easier, too! These installation features are decided advantages that save electrical contractors time and material, time and money.

Buy and try Republic ELECTRUNITE E.M.T. on your next job, and check the savings. Call your Republic representative, or write for complete information.



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ELECTRUNITE KEEPS PRODUCTION SCHEDULES ON TIME! And future electrical loads can be increased easily because ELECTRUNITE's exclusive "INSIDE-KNURLING" with SILVERSLICK finish makes wire pulling up to 37% easier, wire pushing easier, too. ELECTRUNITE is produced to meet local, state, and national codes, and carries the Underwriters' Laboratories Seal of Inspection.

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STEEL AND TUBES DIVISION
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Sylvania cuts starter failures by 98%!

What's the secret? Every Sylvania starter has a *ceramic* condenser! Other starters have paper condensers. Heat, cold, moisture knock 'em out. But not Sylvania starters!

HERE'S PROOF! In a two-year test in one manufacturing plant (installations were two-lamp, 40-watt industrial type fixtures), Sylvania fluorescent starters had

only 1 failure out of 340 starters

Conventional starters with paper condensers had

51 failures out of 330 starters

No wonder Sylvania can sell the only starters with an *exclusive* Light Insurance Policy that guarantees: "If at any time, in your opinion, any Sylvania Fluorescent Starter fails to give satisfactory service during the 12 months from date of purchase, it may be returned to the supplier for full refund of purchase price." This is your assurance of lowest TCL (Total Cost of Lighting), which means cost of lamp plus power plus maintenance.

For all types of starters, call your Sylvania representative, or write: Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P.O. Box 2190, Station "O," Montreal 9.

SYLVANIA
Subsidiary of
GENERAL TELEPHONE & ELECTRONICS

Handy Chart for PF Correction

The following table presents a quick and handy method for determining required KVAR of power factor capacitors to raise the power factor of a circuit. It is a simple matter of multiplying the given kw load by the table constant at the intersection of the existing and corrected values of power factor.

TYPICAL PROBLEM: With a load of 500 kw at 70% power factor, it is desired to find the required KVAR of capacitors to raise the power factor to 80%.

SOLUTION: From the table select the multiplying constant at the intersection of "70% existing" and "80% corrected." This is 0.270. Multiplying by 500, we get—0.270 × 500 kw = 135 KVARs needed.

Existing Power Factor—Percent	Corrected Power Factor—Percent.					
	100%	95%	90%	85%	80%	75%
50%	1.732	1.403	1.247	1.114	0.982	0.850
52	1.643	1.314	1.158	1.025	0.893	0.761
54	1.558	1.229	1.073	0.940	0.808	0.676
55	1.518	1.189	1.033	0.900	0.768	0.636
56	1.479	1.150	0.944	0.861	0.729	0.597
58	1.404	1.075	0.919	0.786	0.654	0.522
60	1.333	1.004	0.848	0.715	0.583	0.451
62	1.265	0.936	0.780	0.674	0.515	0.383
64	1.201	0.872	0.716	0.583	0.451	0.391
66	1.138	0.809	0.653	0.520	0.388	0.256
68	1.078	0.749	0.593	0.460	0.328	0.196
70	1.020	0.691	0.535	0.402	0.270	0.138
72	0.964	0.635	0.479	0.346	0.214	0.082
74	0.909	0.580	0.424	0.291	0.159	0.027
75	0.882	0.553	0.397	0.264	0.132	
76	0.855	0.526	0.370	0.237	0.105	
78	0.802	0.473	0.317	0.137	0.052	
80	0.750	0.421	0.265	0.132		
82	0.698	0.369	0.213	0.080		
84	0.646	0.317	0.161	0.028		
85	0.618	0.289	0.133			
86	0.593	0.264	0.108			
88	0.540	0.211	0.055			
90	0.485	0.156				
92	0.425	0.096				
94	0.425	0.096				

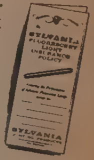
Now One Sylvania 200 watt VHO Powertube

gives more light than a lighthouse!

Many lighthouses don't deliver as much light as this *one* 8-foot Sylvania VHO Powertube. 15,000 lumens! Smooth, white, and no glare!

It's not surprising that more and more companies use Sylvania VHO (Very High Output) Powertubes in all sizes—indoors and out! Only Sylvania Powertubes give you all this:

- **2½ times more light** than you get from standard fluorescent lamps of the same size.
- **Smooth tubular surface** doesn't catch or hold dust.
- **Less weight, easier to handle.** Powertubes weigh *half* as much as other shapes, no "heavy" fixtures needed.
- **Slimmer size.** T-12 1½" tube diameter means better air circulation around tube than larger diameter lamps.
- **Uniform light distribution.** Sylvania VHO Powertubes deliver full light output in any position.
- **Better control.** Light can be *directed* where you want.
- **Lowest TCL—total cost of lighting**—means lowest cost of lamp plus power plus maintenance.
- **Exclusive Light Insurance Policy.** "If at any time a Sylvania Fluorescent Lamp fails in your opinion to provide better performance than any other brand fluorescent lamps, on the basis of uniformity of performance, uniformity of appearance, maintained brightness and life, it may be returned to the supplier for full refund of purchase price."



EXTRA! INSTALLATION SERVICE. Sylvania has also developed a more effective directional control for fluorescent lamps. Called CFR (Controlled Fluorescent Reflectance), it brings greater efficiency, light reflectance from VHO Powertubes. Call your Sylvania representative, or write: Sylvania Lighting Products, a Division of Sylvania Electric Products Inc., Dept. 15, 60 Boston Street, Salem, Mass. In Canada: Sylvania Electric (Canada) Ltd., P. O. Box 2190, Station "O," Montreal 9.

SYLVANIA

Subsidiary of **GENERAL TELEPHONE & ELECTRONICS**

ELECTRICAL CONTRACTOR
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Intermatic®
TIME SWITCHES
Result: MORE DEPENDABILITY

It's the tough jobs that separate a quality product from an "also ran." That's why more and more Electrical Contractors are using Intermatic switches for every conceivable timing job. They count on engineered Intermatic reliability and accuracy for top-notch operation year in and year out under the most extreme conditions. Reliability that means more customer satisfaction and fewer call backs to save you time and money on every job!

REASONS "WHY" INTERMATIC IS YOUR BEST BUY!
Snap-out mechanism for faster, easier mounting . . . 31 cubic inches of wiring space to work in without getting finger cramp . . . Top on the job performance with a heavy duty motor and 40 Amp rating (4375 watts tungsten rated) . . . Hi-Power switching mechanism and U-Beam* Switch Blades assure long life . . . E-Z See Dial for faster, more accurate settings. It figures: Intermatic gives more switch for every dollar . . . more performance for every job.

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• 125-250 Volts • 10 seconds to 23 hour timings • 1 to 96 operations per day • Up to 55 Amps • One or two circuits • Standard or "Skipper" models

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Gentlemen: Please send me your catalog on the complete Intermatic Time Switch line. Bulletin 110-B
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CITY__________ZONE____STATE____
MY DISTRIBUTOR IS________________

480/277 VOLTS IN AN OFFICE BUILDING

[FROM PAGE 85]

on each floor contains the above mentioned 480/277-volt panel, a small (9-kva) dry-type transformer suspended from the ceiling and 120/208-volt panels for 120-volt lighting and receptacle circuits. The transformer primary is fed from a circuit in the 480-volt panel and the secondary feeds the 120/208-volt panel.

Aluminum Conduit

Throughout this installation, all conduit—in sizes from ¾ in. to 3½ in.—is rigid aluminum. Most of the conduit is run exposed—through electric closets for the risers, in the basement, in mechanical rooms and in suspended ceilings. Some conduit runs for miscellaneous 120-volt circuits are run in concrete floor slabs. Bushings and locknuts throughout were also aluminum. An interesting note on this job was a spec requirement that all threaded joints and connections in the aluminum conduit system have an application of a petroleum-base compound containing suspended metal particles to provide a low-resistance, corrosion-protected contact.

Thomas Reilly of Frame Electric reported that their electricians are favorably disposed to working with aluminum conduit. He said carrying and handling the conduit is made easy by its comparatively light weight. Bending was done faster and easier, with a bender made for aluminum conduit. Cutting in sizes up to 1¼ in. was done with hand hacksaws. For larger sizes, cutting was done by a rotating abrasive wheel which produced quick, clean cuts with no burrs on flaring-in of the cut ends. Threading was a straightforward operation, posing no problems. A standard sulphur-base cutting oil was used as the threading lubricant and, as is always this contractor's practice, only sharp dies were used.

Pulling of conductors in the aluminum conduit was a fairly conventional matter. A compressed-air gun was used to shoot a nylon cord through the run. Then instead of pulling in a steel fish rope, a heavy nylon rope was pulled in. It was found that this nylon rope permitted faster pulling of conductors.

Architectural design of this building was done by Harrison and Abramowitz, New York City.

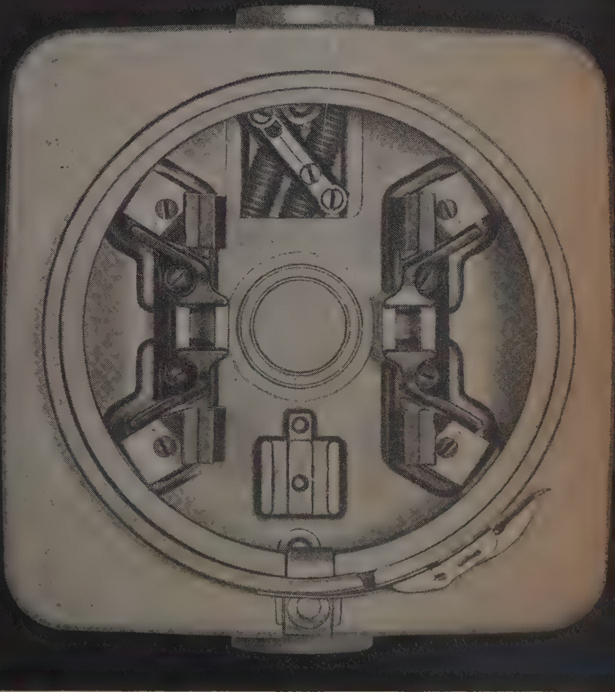
NEW S-2 TERMINAL BLOCK ASSEMBLY—with exclusive one-piece combination jaw and connector strap—permits an unbroken current path from meter blades to line wires for excellent electrical conductivity, low heat rise, for added reliability.

NEW PLUG-IN TERMINAL, another General Electric S-2 exclusive, installs in seconds—without tools, and without removing any part of the meter socket . . . greatly simplifying shop or field conversion to five or six terminal sockets.

EXCLUSIVE SQUARE DIE-CAST ALUMINUM CASE—with baked-on all-weather finish—gives maximum strength, corrosion protection . . . provides full raintight construction . . . unitized hubs. And, modern styling eliminates sharp, hazardous corners.

General Electric Announces...

NEW S-2
SQUARE METER SOCKET



General Electric S-2 sockets—for all 100-amp services—offer two exclusive new features providing greater reliability, increased versatility.

GREATER RELIABILITY is provided by unique one-piece combination jaw and connector strap—permitting an unbroken current path from meter blade to line or load wires with minimum heat rise.

INCREASED VERSATILITY results from the only true plug-in terminal on the market today . . . installs in seconds—without tools—for easy conversion to five or six terminal socket.

PLUS 6 EXTRA VALUE FEATURES

1. Largest wiring space of any die-cast socket—144 cubic inches—permits fast, easy wiring.
2. Die-cast aluminum case—plus baked-on finish—protects against corrosion and weather.
3. Lay-in wire connectors accommodate both aluminum and copper wire.
4. Positive one-way knockouts provide a perfect knockout every time . . . eliminate prying or bending.
5. Choice of neutral connectors—two channel or single lay-in neutral connector.
6. Unitized hubs are cast as part of case . . . no extra charge for second hub at bottom.

NOW AVAILABLE. *Contact your G-E Sales Office or Authorized Distributor for full S-2 information. Or, write General Electric Company, Somersworth, N. H.* 711-01

METER DEPARTMENT

GENERAL ELECTRIC

PLUGMOLD

PLUGMOLD 3000, for standard single-gang box devices. Holds, without devices, up to 10 No. 6 conductors.

GIVES

PLUGMOLD 2200 serves as baseboard, multi-outlet system, perimeter raceway. Holds up to 10 No. 10.

MORE

PLUGMOLD 2100, for Wiremold devices rated at 15A, 125V; 10A, 250V. Without devices, holds up to 5 No. 6 conductors.

OUTLETS

PLUGMOLD 2000 has pre-wired sections for short runs, Snapicoil for long runs. Holds 3 No. 12.

FOR

TELEPOWER is pair of parallel Plugmold raceways, one for communications, one for power and light.

LESS

ONE-PIECE raceway by Wiremold comes in four sizes for surface wiring of any building, new or old.

MONEY

WIREMOLD®
DEPT. EO-11 • HARTFORD 10, CONN.

[FROM PAGE 89]

illustrate a point. The three estimate the same projects and come up with the same answer. How can this be?

In the first place, the standard tables are not the same because the authors have varying ideas as to what such units should embrace and what type of installation they should represent. Secondly, the three estimators arrive at the same job costs because they adjust their own units to cover any items of labor cost they know are not included in the basic units.

There are three prime reasons why tables of individual standard units show considerable variation:

1. The authors do not use the same type of project as a base standard. One may use a simple project with unusually good working conditions. Another may deem it advisable to use a more complicated project as a base.

2. The units do not (and are not intended to) cover the same labor costs. We have seen how estimators' opinions vary regarding where incidental labor, supervision, etc., should be charged.

3. Opinions vary as to how much above normal experienced costs the units should be. Some contractors prefer units representing values close to minimum costs. Others prefer units that represent costs 10% to 20% above experienced normal. The more substantial units are preferred by the majority of better estimators. Reasons for the opinion differences and the merits of the two types of tables will not be pursued here.

Plus or Minus Normal—Labor units frequently are adjusted above or below "experienced normal" to match the estimator's concept of field and installation conditions that may be encountered on a specific project. Degree of adjustment depends upon the makeup of the estimator's units and his own considered judgment.

Assume that the units in each table of Fig. 1 represent the same operations and those of Estimator "B" (medium) are considered normal. Three jobs come up for figuring and fall into the following cost categories: Job No. 1—25% above normal; Job No. 2—normal; Job No. 3—25% below normal.

In figuring the three projects, estimators "A," "B," and "C" would have to adjust their individual labor units as shown in Fig. 2. The bar graphs in Fig. 3 represent the three jobs and the comparative adjustments made by the three estimators figuring each project.

Any one of the estimators could use the labor unit tables of the others if he knew:

1. How much the units were above or below his own experienced costs.

2. That each unit embraced the same labor costs as his own corresponding unit.

3. That the units were consistently high or low.

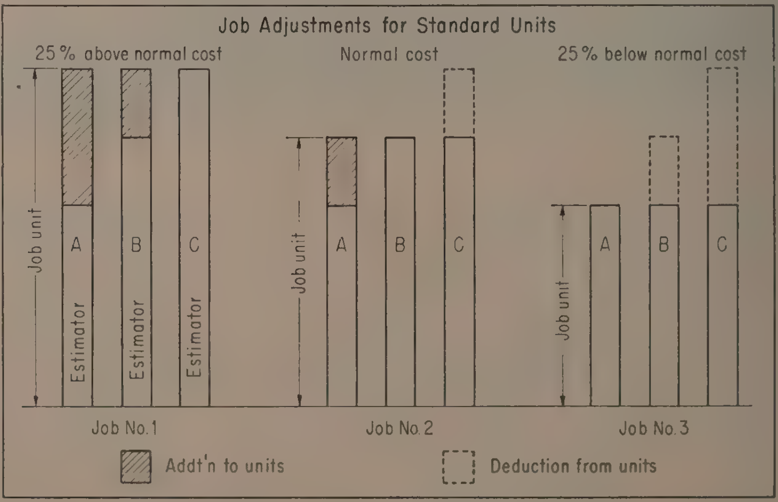


FIG. 3. Bar graph illustrates equalizing effect of job adjustment of individual standard labor units. Basic units of the three estimators vary considerably, but level off when adjusted to specific job cost conditions.

LOWER YOUR ON-THE-JOB COSTS WITH CORNISH

a. **CORNISH "Y" AND "W" COR-LOCK POWER JUNCTIONS** increase the number of available outlets, provide properly insulated connections and eliminate possibility of disconnection of any tool once connected. All wiring device components are UL approved. **b.** **CORNISH HEAVY DUTY EXTENSION CORD SETS, TWISTLOCK TYPE,** for positive locking of male and female components...rated at 20 amperes, 250 volts 10 amperes, 600 volts and 15 amperes, 125 volts 10 amperes, 250 volts. Components are UL approved. **c.** **CORNISH PORTABLE LITE-LINE** for wherever temporary lighting or power is needed. Molding to connectors and sockets provides full protection from rough handling and weather. Standard Lite-Line is supplied with 10 ft. spacing between sockets; has shade-holder grooves for reflectors or lamp guards. ■ All 3 available through electrical distributors from coast-to-coast.

CORNISH

Cornish Wire Company, 50 Church St., New York 7, N. Y.

HUBBELL CHEM MARINE®

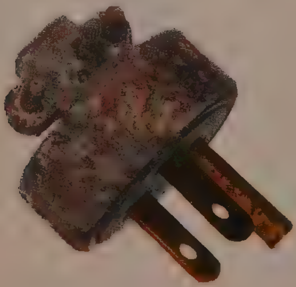
CORROSION

WIRING DEVICES FOR

"I AM CORROSION . . . and wiring devices are my dish!

"See that beat-up cap at the bottom of this column? Six months ago, it was bright and shiny when they installed it in an industrial plating room. But look at it now! Completely useless . . . and dangerous too!

"Mister! I can do the same to *any* wiring device you name . . . unless it's one of those new Hubbell Chem Marine items. Frankly, they've got me licked!"



SPECIAL INSULATION
Melamine*, Fiberglas*, porcelain, or Insulprene® to resist oils, hot water, live steam, grease and most acids.

MONEL METAL
. . . for cord grips and other exterior non-current carrying metal surfaces. Resists corrosion.

HEAVY NICKEL-PLATED CONTACTS
assure constant contact throughout the life of the unit.

Special Materials Insure Long Life in Corrosive Areas

Practically every industrial plant has areas where corrosive materials or high-humidity atmospheres send ordinary wiring devices to the trash can in a year or less. That means extra expense, extra bother, and sometimes production delays.

No wonder Hubbell Chem Marine Corrosion-Resistant devices are getting a red-carpet welcome from maintenance men, purchasing agents, and safety engineers! Their brass current-carrying parts are heavily nickel-plated for extra protection. Other metal parts are corrosion-proof Monel* Metal. And instead of conventional insulating materials, Insulprene®, Mela-

RESISTANT

EVERY INDUSTRIAL USE

WHO'S BUYING THEM?

Sewage disposal plants
Fertilizer plants
Breweries
Meat packers
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Public utilities
Chlorine testing
Parking lots
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Filtration areas

mine*, Fiberglas*, and vinyl compounds are used because they withstand oils, greases, most acids, heavy impact, live steam, and extremes of temperature.

To meet the growing industrial demand, the Hubbell Chem Marine Corrosion-Resistant line is now available in Twist-Lock®, Seal-Tite®, Weatherproof, and straight blade devices.

Write now for catalog pages showing the complete line.

CORROSION-RESISTANT WIRING DEVICES

HARVEY HUBBELL, INCORPORATED

Bridgeport 2, Connecticut

IT PAYS TO HAVE GOOD CONNECTIONS

*Reg. trademarks of Inco, American Cyanamid, and Owens-Corning respectively.

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SORGEL'S SPECIALIZATION

assures Quiet Quality dry-type transformer performance that's the finest in the industry

Since 1916 the principal products at Sorgel Electric Company have been dry-type transformers. Because of this long-time pioneering, specialization and experienced engineering, Sorgel customers are assured of continuous, more dependable transformer performance.

The Quiet Quality of Sorgel dry-type transformers provide the highest efficiency, which reduces operating costs. Sorgel specialization assures a product that requires little or no maintenance, and a design that's easy, more economical to install.

Imaginative progress has been, and is being, made every day at Sorgel. In all forms of modern electrical distribution the Sorgel product is your best buy in stepping down higher distribution voltage to utilization voltage for institutional, commercial and industrial buildings. Look for the Sorgel mark, and when you find it, you'll know this electrical installation was the first choice of a quality-conscious Consulting Engineer, Plant Engineer, Contractor or End-user who wanted to assure dependable, uninterrupted electrical distribution.

Complete Line for Every Purpose up to 10,000 Kva, up to 15,000 Volts,
Including Special Transformers and Saturable Reactors

SORGEL ELECTRIC COMPANY

836 West National Ave., Milwaukee 4, Wisconsin

Sales engineers in principal cities. Consult the classified section of your telephone directory or communicate with our factory.

Product News

Ceiling System (1)

A new ceiling system, called Sonolume, delivers up to 200 footcandles with Power-Groove lamps. It combines direct open illumination with diffused illumination, and offers sound absorption "built-in" to the shielding media. Modules float free from walls, may be used as individual units or joined as an over-all ceiling system. It consists of 8- by 6-ft modular units, only 7 in. deep. A patented hanger coupling bracket is provided for use at each intersecting joint. System makes it possible to replace lamps without removing shielding.

Smithcraft Corporation, Chelsea 50, *Mass.*

Circuit Breaker (2)

A new design of 5-kw air magnetic circuit breaker and switchgear combines stored-energy closing and ironless blowout to provide faster fault interruption and faster contact closing in a smaller size assembly. The new design is available in a conventional indoor type of switchgear and in two types of outdoor configuration—standard enclosed and full walk-in. These units are for use in industrial and commercial buildings for switching, control and protection of such equipment as motors, generators, distribution circuits, transformers and other electric machinery. The stored-energy feature employs a motor-charged, spring-powered mechanism which provides faster closing of contacts, improves contact life and affords greater safety to personnel. The ironless blowout feature provides a reduction in arc chute weight for easier handling and fast arc extinction.

I-T-E Circuit Breaker Company, 1900 *Hamilton St., Philadelphia* 30, *Pa.*

Scaffold (3)

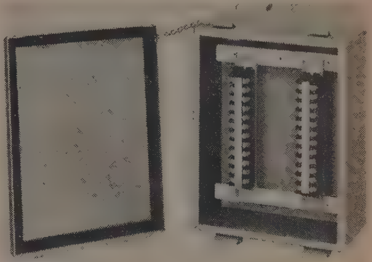
A new work platform, known as step on scaffold, is electrically operated. Worker steps on, presses a button, and rises automatically to a height of 20 ft. It is made of steel and can be rolled by one man. Unit is ideal for any general overhead maintenance.

Atlas Industrial Corp., 849-39*th St., Brooklyn* 32, *N.Y.*

Lighting Fixture (4)

The Photometric unit is available in 4-and 8-ft lengths, and is less than 4 in. deep. Unit is styled with an injection molded 4-ft refractor in styrene or acrylic, easily removed for relamping or cleaning. Fixture is designed for either close ceiling or stem mounting. Units are modular in length. All steel parts are white enameled. Photometric is designed for schools, offices, libraries, drafting rooms, laboratories and residential use.

Wakefield Company, Vermilion, Ohio.



Terminal Boxes (5)

Oil and dust tight JIC boxes with mounting brackets for terminal blocks are furnished complete with sectionalized terminal blocks or with straps, for user mounting of blocks. Terminal blocks are screwed to steel straps which are mounted across brackets in box. Standard box sizes range from 8 by 6 by 3½ in. to 16 in. by 14 by 6 in. Boxes furnished with blocks have from 18 to 64 terminals. They are made of 14 gauge steel and have screw-clamps to close gasketed covers.

Hoffman Engineering Corp., Anoka, Minn.

Switch (6)

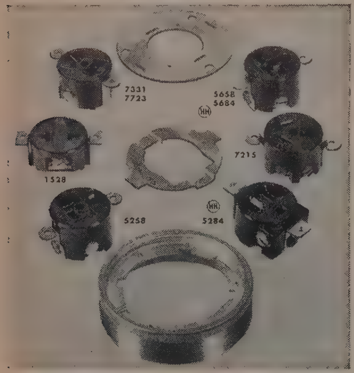
The Loadmaster 100, a drawout protective device for low-voltage, 600-volt, switchgear, is an electrically operated fused interrupter switch utilizing Buss Low-Peak dual-element high-interrupting-capacity fuses. It has a rated interrupting capacity of 100,000 rms symmetrical amperes. Unit gives complete protection against single-phasing. It may be safely closed into its full fault-interrupting capacity. All Loadmasters are arranged for remote electrical close and trip, and available in 800- and 1600-amp continuous ratings.

Pennsylvania Transformer Division, McGraw-Edison Co., Box 330, *Canonsburg, Pa.*

This "KEY" Fits
Most Popular
RECEPTACLES
Found at Your
DISTRIBUTORS

This "KEY" which has been added to our #190 series—*at no extra cost*—was designed to fit most popular size and style receptacles.

The "KEY" drops easily into special slots in adjusting ring—you select the receptacle required and simply "LAY-IN"; then "LAY-ON" receptacle ring. That's all—no more ears to clip—very easy to install.



FULLMAN'S
Adjustable
STEEL BOX
190-N R Series
No Receptacle

Our #190 series is a standard 4" octagon, sheet steel box and takes ½" up thru 2⅜" abandon plug. Box-body opening is plenty large for complete hand access from top of concrete to bottom of box.

A second tin lid is provided for pouring concrete to very top.

Sold Only Thru Wholesalers

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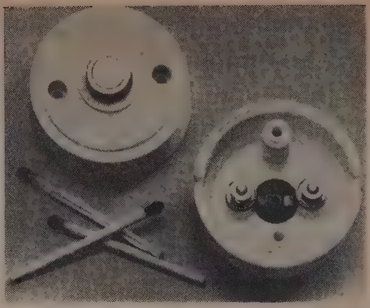
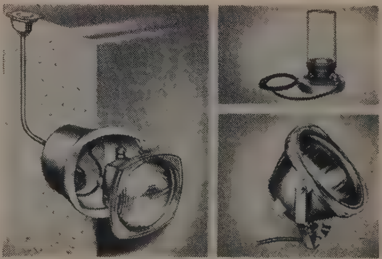
LATROBE, PENNSYLVANIA



Fire Detector **(7)**

Dust-and-moisture-proof automatic fire detectors are self-restoring and feature hermetically sealed elements, oversize wiring terminals and gold plated contacts. For use in commercial, industrial and residential fire protection systems. When temperature near a detector rises above a pre-determined point, a circuit closes causing a warning device to sound. Thermostat cap of units are color coded to indicate temperature ratings — silver caps for units operating at 135°F, black caps for a 190°F setting. Up to 400 sq ft of unobstructed area, 20 by 20 ft, can be protected by a single detector. They are designed for mounting directly on ceiling. An adapter plate is also available for mounting on a 4-in. octagon box or, for semi-flush installation, on a 3¼-in. plaster ring.

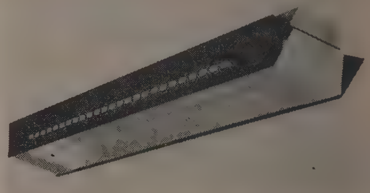
Edwards Company, Inc., Norwalk, Conn.



Swimming Pool Lights **(8)**

A new decorative cast-bronze swimming pool light produces 51,000 candle-power on only 12 volts. Low-voltage "safety-light" concentrates its entire output in a flat, high-intensity beam that is effective for all small and medium size pools where few lights must provide full-coverage illumination. A long rubber-jacketed cord permits wet-niche pool light to be surfaced for servicing without emptying pool or disturbing electrical connections. Units are available with clear or colored flood, spread or deflecting lenses for special underwater lighting effects. Pre-formed copper niches, cast-bronze deck boxes with step-down transformers, and other accessories permit installation in new or existing concrete, gunite, tile, steel or fiberglass pools. Complete underwater line includes fountain and wet-niche pool lights for 200- and 300-watt standard voltage 2000-hour sealed beam lamps, 100- and 200-watt cascade and pond lights, and fully submersible junction boxes, all in cast bronze or heavily anodized cast aluminum. All fixtures are UL-listed for underwater service. Catalog G is available.

Stonco Electric Products Co., 333 *Monroe Ave., Kenilworth, N. J.*



Heater **(9)**

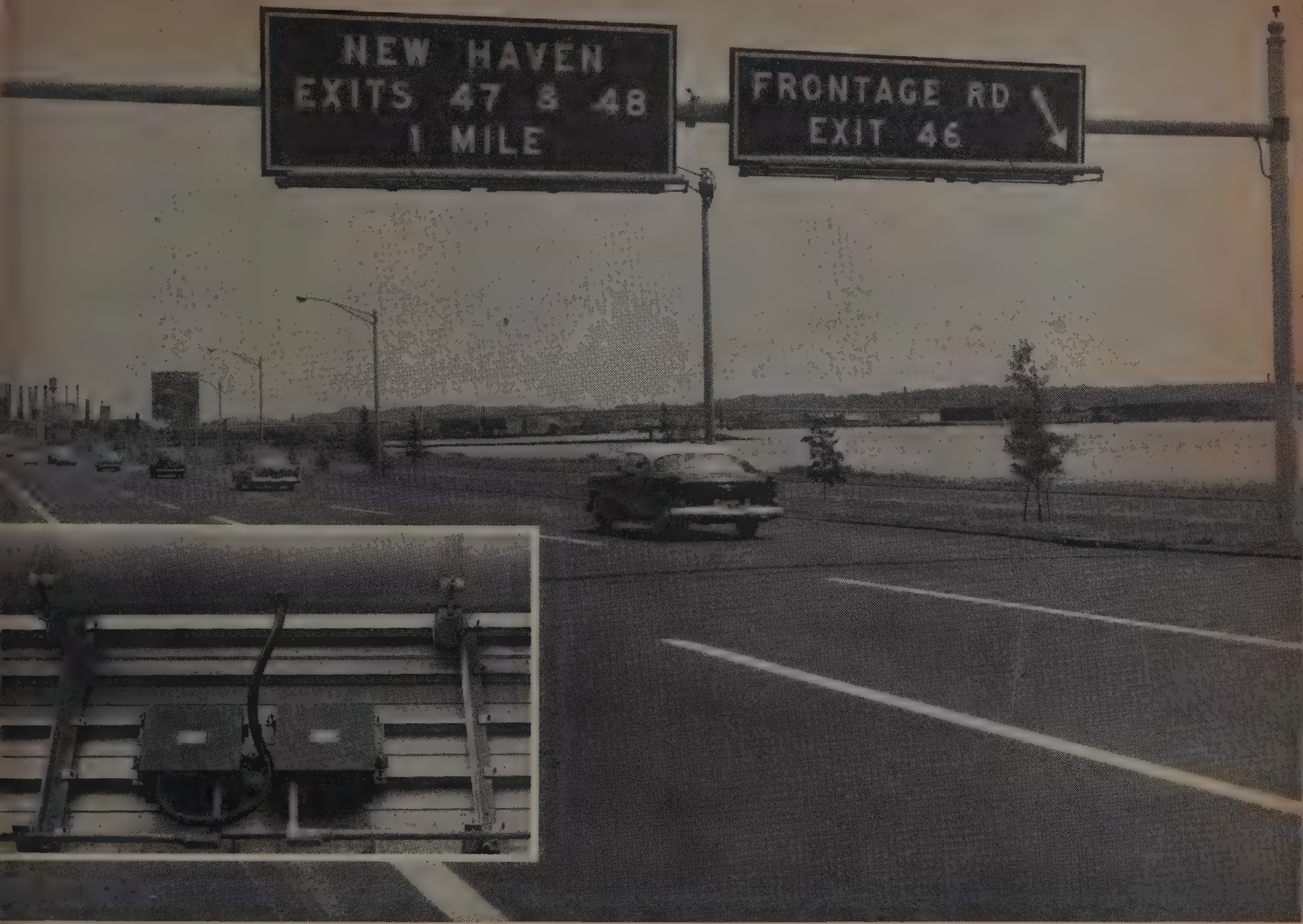
A new line of electric infrared comfort heaters for use in hard-to-heat indoor or outdoor areas. They are practical for supplemental heating since they can be installed without disturbing walls, floors, or expensive modification of existing heating plant. Designed for overhead mounting, they can be installed easily. Known as Series CH, they are available in various models for use with linear quartz tubes or with standard high-temperature T-3 linear quart lamps.

Fostoria Corporation, 1200 *N. Main St., Fostoria, Ohio*

Conduit **(10)**

A new aluminum rigid conduit line, in standard trades sizes ½ in. through 6 in., has been made available. Conduits are furnished in 10-ft lengths with threaded coupling attached. Plastic thread protectors are color-coded to facilitate size identification in distributor stocks. Aluminum conduit couplings and elbows of 90°, 45° and 30° are available as standard radius in full range of sizes. Special radius elbows are also available. The line is listed by UL and conforms to Federal Specifications WWC-005450 (GSA-FSS).

Wheatland Electric Products Co., 500 *Logan St., Carnegie, Pa.*



AN EASY WAY TO EXIT OUTDOOR ELECTRICAL TROUBLES —SEALTITE FLEXIBLE, LIQUID-TIGHT CONDUIT

To make sure overhead exit signs stay lit even in the worst weather, the Connecticut State Highway Department proects sign wiring with Sealtite on the modern 129-mile Connecticut Turnpike.

Even the roughest day-in, day-out weather doesn't faze his flexible, liquid-tight conduit. Its tough extruded polyvinyl chloride jacket proves itself in arctic cold and ropical heat. It resists moisture, dirt—even salt spray and corrosive chemical fumes. And – its flexibility absorbs vibration. These are some of the reasons why Sealtite often outlasts rigid conduit – why you should consider it the next time you need the utmost in wiring protection.

WHERE TO GET SEALTITE — Leading electrical wholesalers stock Sealtite in easy-to-handle coils, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite" and "Anaconda" on the cover. Buy it in long lengths on reels or in cartons and cut it on the job to eliminate waste. Your wholesaler also stocks liquid-tight connectors.

Free Booklet S-542 gives full information on Sealtite. Write: Anaconda Metal Hose, P.O. Box 791, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario. Sealtite is approved by Canadian Standards Association.

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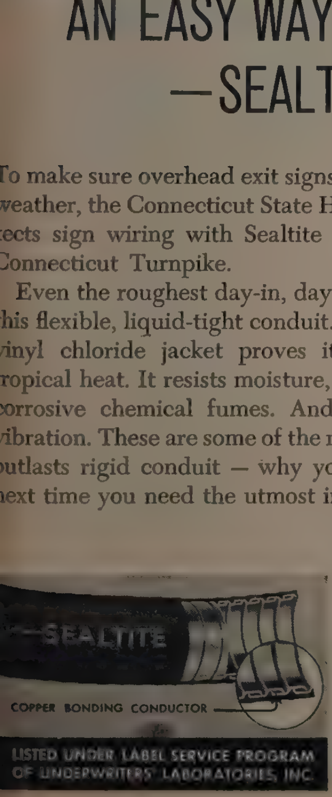
SEALTITE
COPPER BONDING CONDUCTOR
LISTED UNDER LABEL SERVICE PROGRAM
OF UNDERWRITERS' LABORATORIES, INC.

CUTAWAY OF Type U.A. Sealtite shows tough polyvinyl chloride jacket over flexible metal core. Copper conductor wound spirally inside conduit provides positive ground.

Insist on the
conduit marked

SEALTITE®

FLEXIBLE, LIQUID-TIGHT CONDUIT

an **ANACONDA®** *product*

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You Can Do This

. . . and many more combinations

BAKER SCAFFOLDS will do the job faster with greater safety. Check your telephone directory for the name of your local BAKER SCAFFOLD distributor or write to the address below.

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Gentlemen: Send the folder described on Baker Scaffolds without obligation. ECM

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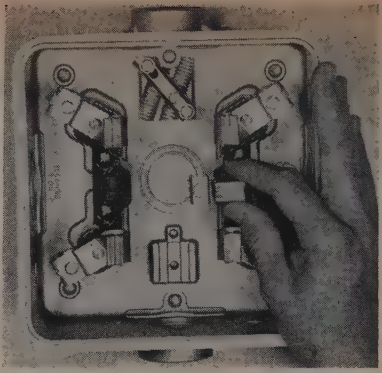


Sockets (11)

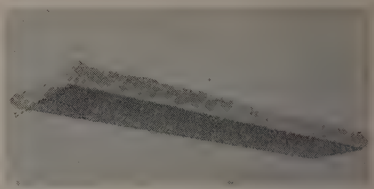
A new line of die-cast aluminum meter sockets with a jaw and connector assembly adaptable to either copper or aluminum wire. Outdoor S-2 socket combines a J-shaped wire connector and terminal jaw that provides a continuous current path from the meter terminal blade to the conductor. Intended for use with modern single-phase watthour meters, socket is rated at a full 100 amps continuous duty. Electrical connection for line and load wires is provided by a J-shaped wire connector that permits a lay-in installation. For field installation, a fifth or sixth terminal can be added without use of tools. It is available with either a single or double neutral connector. Stainless steel sliplock or snap-action rings that lock meter in socket are also available. Dimensions, including cover, are 8¼ by 8¼ by 3½ in.

General Electric Co., Schenectady 5, N. Y.

Bracket (12)

NEMA-standard lighting control pole bracket was designed specifically for street lighting systems that must be adapted at the pole or cross-arm for locking-type lighting controls recommended in current EEI and NEMA standards. Made of cast aluminum, it measures 2¼ in. in diameter to provide a precision fit with controls having NEMA-standard base dimensions. The one-piece seamless casting embodies a ½-in. pipe thread stem for installation on the conduit or relay-boxes normally used on existing poles and cross-arms.

Precision Multiple Controls, Inc., 233 Chestnut St., Ridgewood, N. J.



Fluorescent Fixture (13)

The Regal is a new 2-, 3- or 4-lamp fluorescent fixture with prismatic lens. Any of these lamp arrangements is available in both 4- and 8-ft lengths. Shallow in appearance, sufficient width and depth have been allowed in the design so that the possibility of hot spots has been eliminated. Diffuser is self-centering.

Keystone Electric Manufacturing Co., 2228 E. Tioga St., Philadelphia 34, Pa.

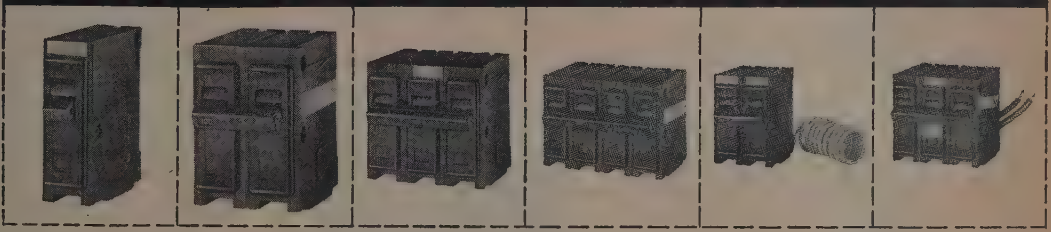
Wiring System (14)

A new pre-wired, multi-outlet twin raceway featuring an "expansion attic" to house future circuiting for energizing lighting fixtures and power equipment has been developed. Miroduct is available in both 2-and 4-ft sections. It can be mounted on floor, wall, or ceiling. Entire system can be altered, expanded, or dismantled and moved without loss of components. Lower raceway of twin system is prewired with 3-wire grounded convenience outlets spaced at 1-ft intervals along length of duct. Upper raceway provides for future circuiting. End plates of each section are reversible for reinforced butting. Listed by UL.

Miroflector Company, Inc., 40 Bayview Avenue, Inwood, N. Y.

I-T-E
Uni-Pak
PANELS

FLEXIBILITY ...AND NOW... MORE CIRCUITS in HALF the SPACE WITH EQ·T



Uni-Pak loadcenters have long offered maximum flexibility, superior construction and exceptional features . . . qualities that have distinguished the I-T-E line.

Now . . . the EQ-T DUAL is available to make the Uni-Pak loadcenter even more flexible than ever. It's a compact, dual-breaker . . . two circuit breakers in a 1″ case. The EQ-T DUAL is quick-make, quick-break, trip-free, with low range instantaneous thermal-magnetic tripping—miniaturized without sacrificing any of the well-known I-T-E quality.

I-T-E plug-in circuit breakers plus the I-T-E Uni-Pak provide the best and most flexible loadcenter line available today.

For additional information, write I-T-E Circuit Breaker Company, Walker Division, 125 Bennett Street, N. W., Atlanta 9, Georgia. Ask for Bulletin NI-100.

I-T-E

I-T-E CIRCUIT BREAKER COMPANY
WALKER DIVISION

QUAD
REFLECTORS

QUALITY INCANDESCENT
REFLECTORS FOR 37 YEARS

INDUSTRIAL LIGHTING

Quadrangle offers America's most complete line of RLM reflectors as well as many other type reflectors. There is a wide range of sizes and a large variety of socket fittings. Many utilize the Quad exclusive Easy-Tach disconnect socket.

FLOOD-LIGHTING

Quad floodlights incorporate design and manufacturing features that are the result of years of research and engineering. There are five different types and more than one hundred and twenty different unit designs to choose from.

SIGN-LIGHTING

There are more than 15 Quad sign reflectors, in a multitude of shapes and sizes, to accommodate lamps from 60 to 1500 watts. There is a size and design for illuminating the smallest signs to the largest outdoor display bulletins.

All Quad Reflectors are rustproof, weatherproof, finished lustrous porcelain enamel. Available with Easy-Tach or Quick-Detachable horizontal, vertical, feed-through or box-type easy-to-wire sockets.

QUADRANGLE MANUFACTURING CO.
Dept. 65, 32 S. Peoria St., Chicago 7, Ill.

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☐ Sign-Lighting

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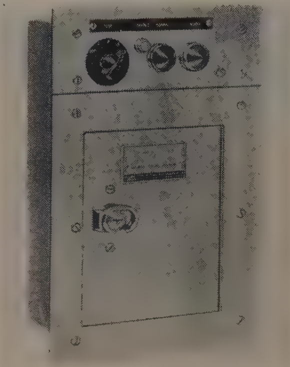
Floodlight (15)

A new high-intensity floodlight using a 500-watt Quartz iodine lamp is available for a wide range of applications where high lumen output and intensity are required. The housing measures $9\frac{3}{16}$ in. wide by $9\frac{9}{16}$ in. high by $5\frac{5}{16}$ in. deep. Floodlight can be supplied as a wide-beam unit for closeup illumination or with a medium beam for longer throw applications. Either model can be pole mounted, wall mounted or overhead mounted. Construction is weathertight. Cast aluminum alloy housing is finned for cooling. Aluminum reflector is designed to provide high intensity with sharp light cutoff. The 500-watt 500T3/Q/CL lamp is $4\frac{3}{4}$ in. long and $\frac{3}{8}$ in. in diameter. Operating at 120 volts, it has a 10,500 lumen output.

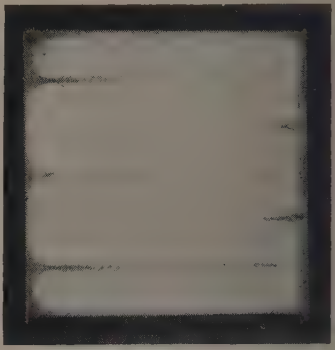
Guardian Light Company, 500 *North Blvd., Oak Park, Ill.*



Warning Unit (16)

A new warning unit detects leakage to ground in isolated voltage systems. It is especially designed for hospital operating rooms and other locations where hazardous grounding of isolating voltage systems may be encountered. UL listed, it will detect a leakage to ground of up to 60,000 ohms, and will allow no more than 2 ma to pass through isolated voltage systems in which it is installed. A green signal light located within view of anaesthetist or other personnel, indicates normal ungrounded condition of system. When a ground occurs, a red light goes on and a buzzer sounds a warning that system is grounded and hazardous. Buzzer may be turned off, but red light remains on until fault is corrected.

Zenith Electric Co., 152 *West Walton St., Chicago* 10, *Ill.*



Fluorescent Lamps (17)

Large, thin, rectangular glass plates $1\frac{1}{2}$ in. thick, produce fluorescent light. The lamps consist of a maze of passages sealed in a thin glass block. The arc or electric discharge travels this winding path through glass block to produce, in effect, a large area source of light. It is designed for use in modular fashion. The 12-in.-sq models will be 40- to 50-watt lamps. They will produce more light than a 100-watt incandescent bulb. They can be used in residences and in commercial buildings.

Westinghouse Lamp Div., Bloomfield, N. J.

Conversion Unit (18)

A new conversion unit comprising a long-life maintenance-free silicon rectifier especially designed for electrostatic precipitators now using outmoded mechanical types. Unit utilizes all existing equipment with the exception of rectifier motor, disc, shoes, suppressor elements and pedestal. It ties in with present ac connections, and also with dc switchgear which distributes the rectified power. Rectifier is made up of four independent rectifier units, and has a choke in output line to protect rectifier from high voltage feedbacks. Each of four rectifier units comprises two racks of silicon diodes immersed in a container of dielectric fluid.

Buell Engineering Co., Inc., 123 *William St., New York, N. Y.*

Spang Headerduct will feed electric, telephone and intercom wiring into floor cells on 28 of the 32 floors at First City National Bank Building, Houston, Texas. This will provide service wherever it's needed and permit speedy changes to meet any future requirements.

In 1990 this Spang Headerduct wiring system will be as modern as it is today!

Houston's new First City National Bank Building is prepared electrically for any future requirements

Nobody knows what kind of electrical service the tenants of First City National Bank Building, Houston, Texas, will need in the year 1990. But this new building will be able to handle their requirements through this SPANG Headerduct system.

Over 31,000 ft of SPANG Headerduct have been installed from the second through 29th floor of the 32-story building to carry electric power, telephone and intercom wiring under the floors.

Future wiring requirements can always be made quickly, because the wiring is accessible by removing the SPANG Headerduct access box covers. This eliminates costly digging into concrete, repairing and redecorating. Cellular floor cells carry the wiring from the headerduct to all parts of the floor at regular intervals, providing convenient wiring service wherever it's needed.

PLAN FOR THE FUTURE WITH SPANG

SPANG Underfloor Duct systems help builders stay modern longer. The engineered design of these products simplifies installation and assures a lifetime of satisfactory service. To suit your requirements, you have a choice of Standard Underfloor Duct, Double-Capacity Duct and Headerduct—plus a complete range of service outlet fittings. For complete information mail the coupon below.

Architect: Skidmore, Owens & Merrill, New York, N.Y., and Wilson, Morris, Crain & Anderson, Consulting Architects—Houston, Texas
General Contractor: W. S. Bellows Construction Corporation, Houston, Texas
Electrical Contractor: Fischbach & Moore of Texas, Inc., Houston, Texas
Spang Distributor: Graybar Electric Company, Houston, Texas

Steel's Symbol of strength, long life, and economy

SPANG UNDERFLOOR DUCT

THE NATIONAL SUPPLY COMPANY
Two Gateway Center, Pittsburgh 22, Pennsylvania
Subsidiary of Armco Steel Corporation

The National Supply Company, Underfloor Duct Department
P.O. Box 416, Pittsburgh 30, Penna.

Please send me a copy of Bulletin No. 491 entitled "SPANG Underfloor Distribution Systems."

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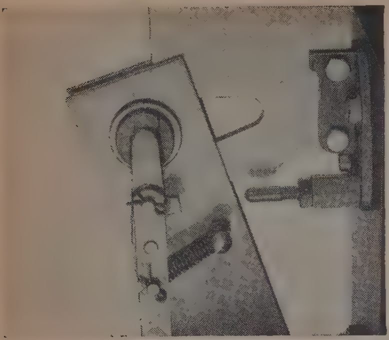
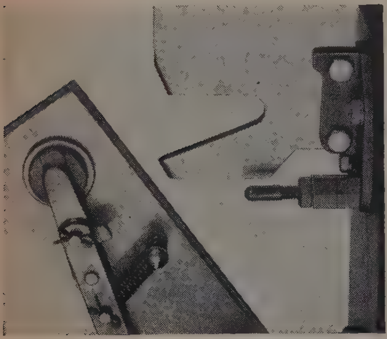


EVEN AFTER 10 YEARS



OF CLOSED OPERATION

yet this
service-entrance switch
requires no maintenance

This is the ultimate test of a service-entrance device. Will it open in an emergency—after remaining closed for years, with little, if any, maintenance? The fused Pringle switch does. Against any overload. Its contacts are bolted together by a simple, rugged toggle mechanism that turns a bolt through the blades, pulling them together, tight against the fixed contacts. There is nothing to loosen, stiffen or fatigue. Nothing that needs any maintenance. Bolted contact pressure is constant, independent of springs, unaffected by heat. It permits this switch (1200 to 5000 amps) to carry full load continuously, with a heat rise at the contact areas considerably less than the accepted 30°C.

The performance of the Pringle switch is a matter of record. Proven in laboratory tests. Confirmed by the fact that many of them have been in service for more than 25 years. The entire story—including models, ratings and load-break test data — is in the Service Entrance Catalog. A copy is yours upon request.

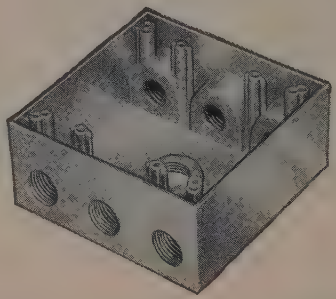
PRINGLE
ELECTRICAL MANUFACTURING CO.
1900 North Sixth Street
Philadelphia 22, Penna.

SA2273

Ventilator-Light (19)

New ventilator-light uses two 60-watt lamps, with Albalite glass diffusers. It offers plug-in connection for fan motor and lights; triple-plated chrome grille. Other features include removable duct sleeve connector, built-in back draft damper, removable junction box. Mounting flanges are adjustable; unit fits between standard 16-in. joists. Snap-in grille is adjustable to plaster thickness.

Progress Manufacturing Co., Inc., Castor Ave. & Tulip St., Philadelphia 34, Pa.



Boxes (20)

New 2-gang weatherproof outdoor boxes feature six and seven openings. The 6-opening box has three outlets on one end, two on the other end and one on the back. The 7-opening box has three outlets on each end and one on the back. Threaded outlets are available in $\frac{1}{2}$ in. or $\frac{3}{4}$ in. diameters. Built-in grounding terminal and screw holes permit use of interchangeable cover plates. Boxes are $4\frac{1}{2}$ in. by $4\frac{1}{2}$ in. by 2 in. deep to house all types of wiring devices and weatherproof plates, or serve as junction boxes. They are listed by UL and CSA.

Bell Electric Co., 5735 S. Claremont Ave., Chicago 36, Ill.

Power System (21)

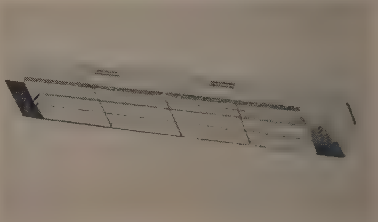
Four models of uninterrupted power systems have been added to the Precise-Power line of rotary electric power systems. They are available in six standard output ratings: 3 kw, 4.5 kw, 9 kw, 16 kw, 21 kw and 25 kw. A Precise-Power system with uninterrupted power consists of a motor-alternator combination to which is added a dc motor-generator and standby battery power-pack. In event of line failure, power-pack supplies the motor-generator acting as a motor to drive the alternator to which it is mechanically coupled, and the power system output remains unchanged. In normal operation the motor of the Precise-Power system drives the alternator and the motor-generator which then acts as a charging source for the battery power-pack. Standard input/output may be ac-ac or ac-dc, 60 or 400 cps, regulated or unregulated.

Electric Specialty Co., 211 South St., Stamford, Conn.

Contact Burnisher (22)

A new contact burnisher for electronic and miniaturized components features a micro-fine abrasive which gives controlled cleaning action. Called the Adre Contact Burnisher No. 180, the unit has a burnishing element $\frac{3}{16}$ in. wide and 0.006 in. thick for cleaning contacts without disturbing electrical clearances. Unit comes in convenient pen-type case which also encloses a 3-in.-long plastic-handled "Slim Grip" burnishing tool which can be bent to work around corners and used in places where cleaning space is extremely limited.

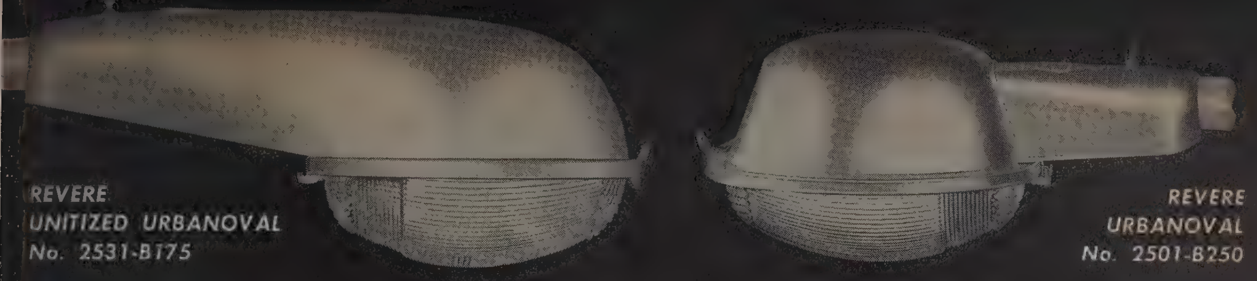
Adre, 8980 West Hawthorne Lane, Hales Corners, Wis.



Infrared Heater (23)

Area spot heater, equipped with quartz tube element, designed to heat personnel, equipment and floor directly under its rays. Heater is available in two lengths—36 and 60 in.; wattages from 1000 to 4,000; 120, 208 and 240 volts. Finished in baked brown Hammertone. Can be suspended from ceiling with sash chains, or mounted on wall with brackets equipped with Bakelite knobs for setting to desired angle. Can be controlled by percentage-timer or thermostat.

Seaboard Products Corp., 189 Frelinghuysen Ave., Newark N. J.



New Revere 2500 Series Urbanoval luminaires use 100, 175 or 250-watt mercury lamps. Unitized Urbanoval features built-in constant-wattage or reactor ballasts. Conventional Urbanoval is designed for external ballasting. Both types are available with or without mounting adapter for E.E.I.-NEMA standard plug-in locking-type photo-electric control. Choice of Revere-Corning Pyrex® molded prismatic refractors provides I.E.S. Type II or Type II—4-way distribution (or Type III or 4-way with phosphor-coated lamps). Available with 1¼" or 2" slipfitter.

NEW FAMILY OF REVERE LUMINAIRES

New *unitized* oval mercury luminaires with built-in ballast components are the latest addition to the Revere family of street lighting equipment. New 2600 Series Endoval luminaires provide high-level, glare-free illumination for arterial streets and highways. New 2500 Series Urbanoval luminaires are designed to provide economical lighting for residential areas or secondary streets where uniform, low-level lighting is desired. Both series offer the advantages of modern styling, substantially reduced installation costs, and efficient, economical performance.

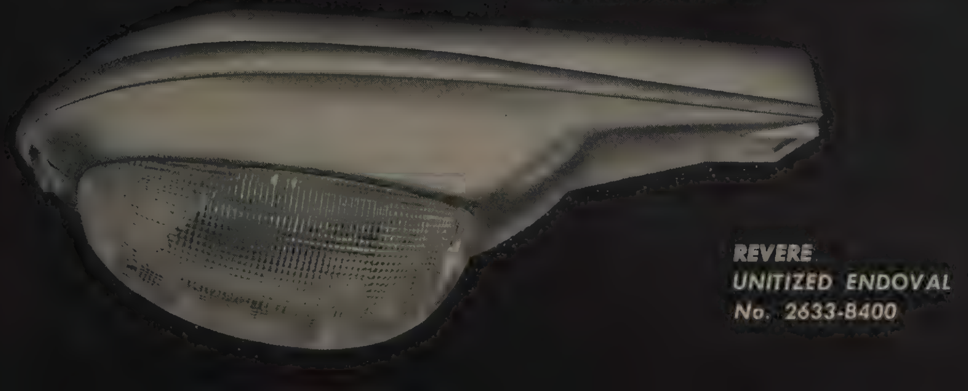
Revere's new unitized luminaires together with newly designed conventional luminaires let you solve every street and highway application problem the one *best* way. You can select high quality, design-matched Revere luminaires, poles and equipment specially engineered for every street lighting need. *Send for complete catalog information and technical data.*

Revere
ELECTRIC MFG. CO.

OUTDOOR LIGHTING

Revere Electric Mfg. Co. • 7420 Lehigh Avenue • Chicago 48, Illinois (In suburban Niles)
Long Distance Phone: NIles 7-6060 • Chicago Phone: SPring 4-1200 • Telegrams: WUX Niles
In Canada: Curtis Lighting, Ltd., Leaside, Toronto, Ontario

New Revere 2600 Series Endoval luminaires use 250 or 400-watt mercury lamps. Unitized Endoval features built-in constant-wattage or reactor ballasts. Conventional Endoval employs same housing, reflector and Revere-Corning Pyrex molded prismatic refractor, but without built-in ballast components. Both types are available with or without mounting adapter for E.E.I.-NEMA standard plug-in locking-type photo-electric control. Adjustable socket positions produce A.S.A.-I.E.S. Types II, III, or IV with proper choice of lamp.



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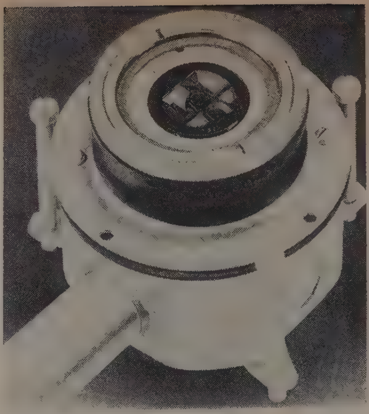


Floor Box (24)

Model "800" series floor box is used to provide a convenient power source for office machines, lighting and communications equipment. Some of the features include ability to accommodate widest range of receptacles, including 2-wire and 3-wire; NEMA grounded, T-slot and twist-lock types through 20-amp capacity. It also has a larger hand-hole for ease of fishing conductors, and a redesigned mounting ring that facilitates easy field installation of intercom, microphone and telephone receptacles. A new floor plate will now accept ½ in., ¾ in. through 1 in. conduit.

H. K. Porter Company, Inc., National Electric Division, Porter Building, Pittsburgh, Pa.

Nurse Call Equipment (25)

The Centron-10 is a new surface mounted lighting and service system for hospital bedrooms, and is adaptable for mounting directly to the surface of any type of wall construction. System incorporates a shallow surface-mounted central console and a prefabricated service leads enclosure which consolidates into one unified "package" up to ten different lighting and service requirements. Service leads may be stubbed into central console either from ceiling, floor or both. It is designed to perform or accommodate the following services. Central lighting provided by a 2-lamp fluorescent component. High intensity, color-corrected exam light on extendable arm. Shielded, narrow beam reading lamp adjusts to any reading position. Shielded night light is centrally located and handy for night nurse. Console is designed to take a variety of oxygen and vacuum system. Various audio-visual nurse call and patient station systems for 2-way communication are adaptable to Centron-10. Console will take two jacks for permanent or plug-in telephone. Two outlets provide for patients' or nurses' use. Console is compartmented to take TV and radio antenna lead-ins.

Sunbeam Lighting Company, Los Angeles, Calif.

Pushbutton Stations (26)

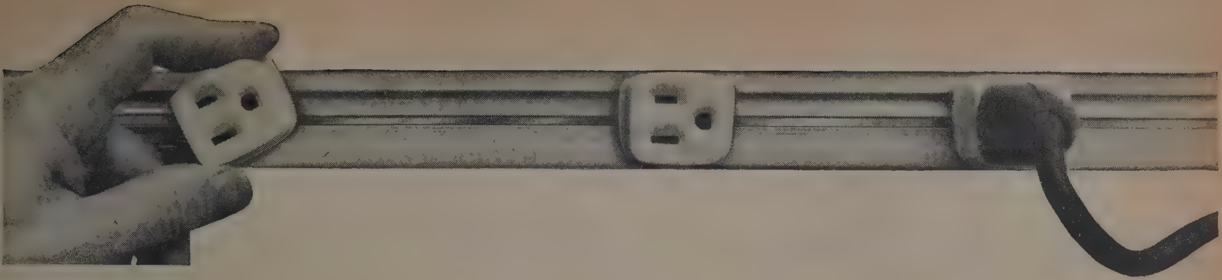
Three new pushbutton lines include: pushbutton units; selector switch units; standard pilot lights; and push-to-test pilot lights or lighted pushbuttons. Bulletin 100 Type HO and H electrical control units are available in following lines: Type HO, oiltight, 1-hole or base mounted. Units are convertible from base to panel mounting and vice versa. Type H, NEMA 1, general purpose, 1-hole panel mounted used for flush plates, operator's panels and benchboards. Type H, NEMA 1, general purpose, base mounted used for surface mounted enclosures. Design features of the combined control unit lines include: interchangeability of many parts between three lines; choice of seven American Standard safety colors for both buttons and ferrules; stationary terminals are silver, wipe-action contacts. Entire series meets NEMA standards for industrial use.

Clark Controller Co., 1146 East 152d St., Cleveland 10, Ohio

Angle Drill (27)

Designed for high-capacity, close quarter work, the 11C-5 drill has the speed necessary for drilling light metals and power to drive large drill bits. Motor diameter is 2¾ in. Capable of drilling ¾-in. holes, peak horsepower is delivered as drilling load slows motor to about two-thirds its free speed. Features include interchangeable attachments, threaded or tapers clutch spindles, muffled exhaust and heavy-duty construction.

Gardner-Denver Company, Quincy, Ill.



Electrical outlets aplenty! More flexible office layout with new 3-Wire Electrostrip

PATENTED ®

New 3-Wire Electrostrip® grounds office machines . . . gives you handy outlets you can move.

Here's absolute electrical safety combined with an abundance of outlet convenience. New 3-Wire Electrostrip is UL listed and meets the electrical code requirements for equipment grounding. Electrostrip outlet receptacles twist into place *anywhere* on the strip. When you relocate machines, you can relocate outlets right where you want them!

See your electrical contractor about 3-Wire Electrostrip. He'll install it swiftly, economically—without mess, without disrupting work schedules. Electrostrip is the safe, modern system for wiring offices, showrooms, shops and institutions. It provides electrical outlets aplenty!

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan. In Canada: 80 Clayson Rd., Toronto, Ont. Export Division: 13 E. 40th St., New York 16, N .Y.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

Installs quickly on wall surfaces

Outlets anywhere you need them

new

93 line

step lights, night lights

. . . for outdoor and indoor applications

surface . . .

. . . or recessed

louver guard or . . .

tempered glass or . . .

. . . prismatic tempered lens.

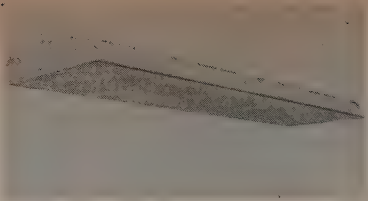
93 line . . .

. . . the widest selection of step lights and night lights available today . . .

weatherproof enclosed and gasketed . . . incandescent or fluorescent . . . all cast aluminum everlasting construction . . . flawless satin aluminum anodized for permanence . . . louver guard or white tempered glass or prismatic lens diffuser available in 3 different sizes.

Ask for complete specification data sheets Section A pages 31/32/33/34.

mc Philben
LIGHTING
1329 Willoughby Ave., Brooklyn 37, N. Y.



Luminaire (28)

New Viking luminaire with its "Opti-Vue" bottom prismatic diffuser. Shielding's side panels are of clear opal and are secured to prismatic section by an interlocking design. Unit is 3¾-in. deep, and inward sloping side panels allow generous overall ceiling illumination. Snap-on covers are quickly installed. Unit will be available in 2-lamp, 4-ft rapid start or 8-ft tandem and 8-ft slimline.

Keystone Electric Manufacturing Co., 2228 E. Tioga St., Philadelphia, Pa.

Switch (29)

New Type "B-2L" line of outdoor hookstick disconnect switches features a 10° blade angle in closed position; fewer current interchanges; new hook ring shape to self-seat the hookstick prong at a point of greatest mechanical advantage; integral pryout device and combination lateral blade latching; positive operation under ice or corrosion conditions. Ratings are 7.2 kv through 69 kv, 600 and 1200 amps. The new line also includes "B-2L," double-throw and "B-22L," tandem-throw switches.

H. K. Porter Company, Inc., Delta-Star Div., Chicago, Ill.

Drives (30)

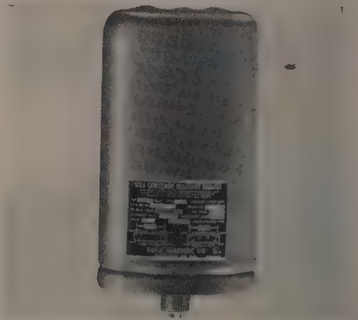
Bulletin 111 Syncro-Range-Drives, ranging in sizes 2 to 15 hp, and providing adjustable speed of synchronous induction motors running in exact synchronism over a wide range of speed are available. Drive is an integrated system consisting of an adjustable frequency power supply, one or more Syncro-Spede drive motors, and a control panel. Adjustable frequency power is supplied from an ac alternator driven by a constant-speed squirrel cage induction motor which provides infinitely adjustable speed through the mechanical interaction of adjustable discs and a ribbed belt. By adjusting power supply output, drive motors can be varied in speed over a wide range, maintaining exact synchronism of all motors at any fixed speed and also while increasing or decreasing speed. Control panel includes alternator field supply and all necessary controls for proper operation of drive.

Louis-Allis Co., Milwaukee, Wis.

Outlet Locator (31)

A new outlet protector and locator uses a blue die-tablet which bleeds through freshly plastered walls, directing the electrician to the plaster-covered outlet. Adhesive protecting tape which covers the blue die tablet prior to use is easy to remove. A minor stamping change provides for handy thumbnail pull up, providing a grasping surface for quick and easy tape removal.

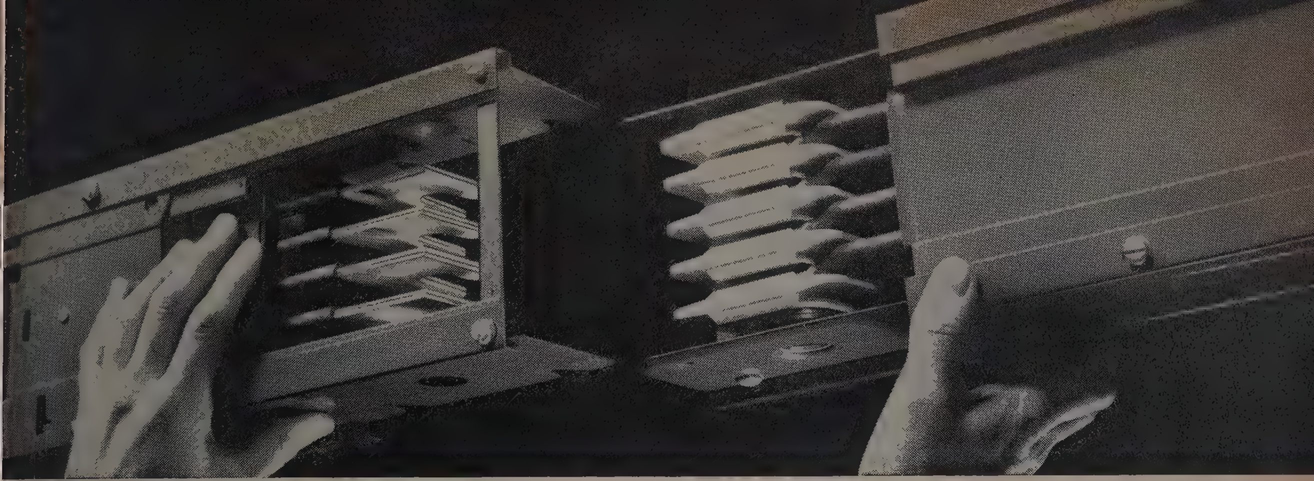
Code Cover Company, Box 88, Oak Park, Ill.



Transformer (32)

New 400-watt 2-lamp parallel mercury transformer features a new constant wattage circuit which provides electrical independence between the lamps. Each lamp is provided with its own series capacitor, and interaction between lamps is negligible. Starting voltage assures positive starting of H-1 type lamps down to minus 20F. Offered in a corrosion-resistant aluminum weatherproof case, the transformer measures 6⅝ in. by 12 in., weighs 47 lbs. It is available in primary voltages of 100-130 volts or 200-260 volts.

Sola Electric Co., Busse Road at Lunt, Elk Grove, Ill.



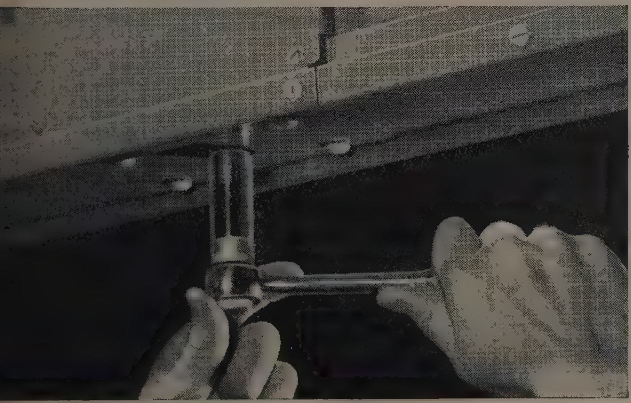
NEW BULLDOG XL BUSTRIBUTION DUCT

CUTS INSTALLATION TIME 3 WAYS

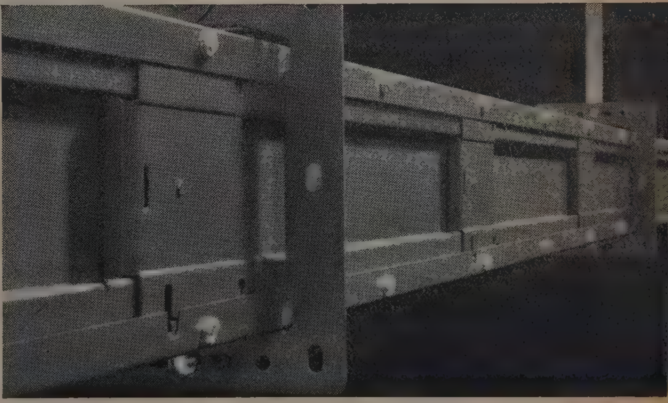
You can install XL BUStribution® Duct easier, faster than any other duct because of these exclusive new design features . . . plated aluminum bus bars with KEYED ENDS slip together fast, align automatically for proper position. There's no fumbling and fitting . . . ONE INTEGRAL BOLT tightens fast, locks joint positively under a ton of pressure. Bolt tightens against bus bar, not against the casing . . . TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

New XL BUStribution Duct is 3 ways safer, too. It's the only true dead-front duct, the only one with exclusive Safety Door, the only one with Safety Plug. And it reduces duct weight on building structure as much as 40%. Ask your BullDog distributor to arrange for a demonstration . . . you'll see how fast to install and how safe new XL BUStribution Duct really is.

BullDog Electric Products Division, I-T-E Circuit Breaker Company, Box 177, Detroit 32, Michigan. In Canada: 80 Clayson Rd., Toronto 15, Ont. Export Division: 13 East 40th St., New York 16, N. Y.



SINGLE INTEGRAL BOLT puts a ton of pressure on keyed bus ends. Joints lock tight *fast*, stay locked.



TEN-FOOT SPANS take fewer hangers and less time to install than ordinary duct.

BULLDOG ELECTRIC PRODUCTS DIVISION
I-T-E CIRCUIT BREAKER COMPANY

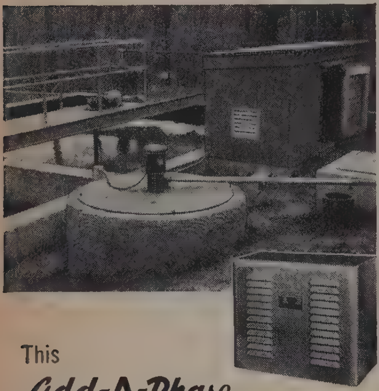
KEEP PACE ELECTRICALLY

★ "MARKETS UNLIMITED" ★

"WE ELIMINATED
$3800.00
IN 3-PHASE WIRING
with the
Add-A-Phase®"

Says RUSS JONES
RUSS JONES CONSTRUCTION CO.
ST. LOUIS BUILDER

"The ADD-A-PHASE enabled us to operate this 3-phase equipped SANITARY SEWAGE DISPOSAL PLANT FROM SINGLE PHASE LINES"



This Add-A-Phase Power Converter is successfully operating the following 3-phase equipment from single phase lines

- 2 H. P. BLOWER
- 1 H. P. AGITATOR DRIVE
- 1/3 H. P. SUMP PUMP

Add-A-Phase units are available for 1 H.P. to 50 H.P. three-phase motors ... write for more information.

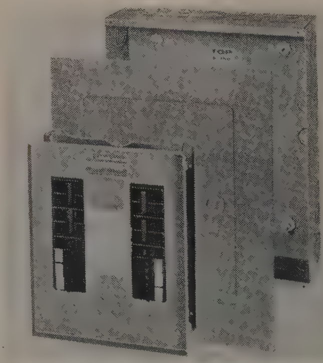
ADD-A-PHASE ECM-11
Div. System Analyzer Corp., Nokomis, Illinois
Gentlemen: Please send, without obligation, complete details on your ADD-A-PHASE Power Converter.
Name__________ Title__________
Company__________
Address__________
City__________ Zone__________
State__________

SEE FOR YOURSELF . . . package includes many case histories of the success of the Add-A-Phase . . . years of trouble free use. IF YOU HAVE A SPECIFIC ELECTRIC POWER PROBLEM GIVE US THE DETAILS FOR RECOMMENDATION.

Burglar Alarm **(33)**

A new photoelectric beam burglar-intruder device, called Lyne-O-Larm, comprises a projector and a receiver. Projector transmits an infrared beam to receiver which can be located up to 250 ft away. Transmission may be either a straight line or, with mirrors, around corners. Any object passing through beam causes an alarm to sound at any desired location. They operate on a low-voltage power supply, 110 ac and transformer, and have a standby battery power supply which takes over if normal power fails for up to four hours. Unit measures $4\frac{3}{4}$ in. deep by $5\frac{1}{2}$ in. wide and $11\frac{3}{4}$ in. high. It is listed by UL.

Kidde Ultrasonic & Detection Alarms Div., Walter Kidde & Company, Inc., Clifton, N. J.

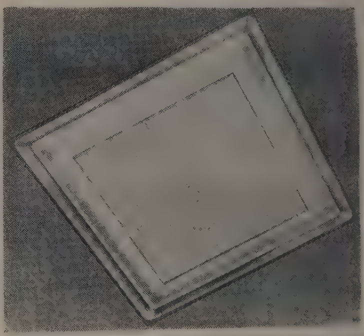


Loadcenters **(34)**

A new line of Uni-Pak loadcenters for the EQ-T dual circuit breaker and a new 100-amp 2-pole EQ-P circuit breaker. Loadcenter incorporates the new non-interchangeability provisions. EQ-T dual circuit breaker is a new dual breaker the same size as the single pole EQ-P circuit breaker, but consisting of two separate half-size independently operated breakers. They are designed for use in residential loadcenters and panelboards and feature a thermal-magnetic trip design with a low instantaneous trip setting. Breakers are equipped with pressure wire connectors for straight-in wiring and plug-in line terminals that permit them to be used in the new Uni-Pak line and existing residential loadcenters and panelboards, with 1, 2 and 3-pole EQ-P breakers. They are available with both poles calibrated at 15 amps, 20 amps, or a combination of 15 and 20 amps. Interrupting rating is 5000 amps at rated voltage. Listed by UL.

The 100-amp 2-pole EQ-P takes up only two pole spaces in loadcenter. It can be used to convert dual-rated Uni-Pak main-lugs-only loadcenter to a single main disconnect loadcenter or can be used as a 100-amp branch or subfeed. Bulletin NI-100 is available.

Walker Division, I-T-E Circuit Breaker Co., 125 *Bennett St., N. W., Atlanta* 9, *Ga.*



Lighting Unit **(35)**

A completely enclosed unit, called the Lyric, features a large polystyrene plastic dish shielding with molded corners. Unit is available as a surface unit or as a coffered unit, with a fiberglas plastic flanged coffer shell, or with a coffer for plaster ceilings. Lyric comes in 2- by 2-ft, 2- by 4-ft and 4- by 4-ft sizes. Polystyrene shielding is available with a plastic louver insert, or as a regular one-piece shielding.

Smithcraft Lighting, Chelsea 50, *Mass.*

Lighting Unit **(36)**

A new sealed beam, self-contained lighting unit is capable of providing 300,000 candlepower with a consumption of 1200 watts. The new Cleco sports lights are available in 18 models and are produced in a wide range of styles to serve a variety of applications including tennis courts, football fields, baseball fields, parking lots, etc. Hermetically sealed lights with sealed-in reflector are weatherproof.

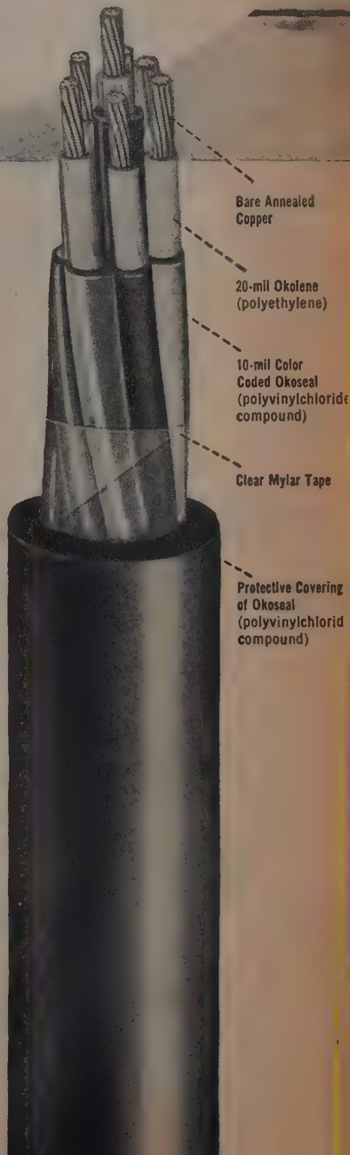
Commercial Lighting Equipment Co., 8636 *Graham Ave., Los Angeles* 2, *Calif.*

NOW... a small, light, easy-to-install plastic control cable...

OKONITE

P-30

small diameter plastic control cable


Bare Annealed Copper
20-mil Okolene (polyethylene)
10-mil Color Coded Okoseal (polyvinylchloride compound)
Clear Mylar Tape
Protective Covering of Okoseal (polyvinylchlorid compound)

SMALL-CABLE SIZE, BIG-CABLE PERFORMANCE. That's the story on Okonite's new P-30—the multiple conductor cable designed especially for modern control systems where space is limited. Suitable for either a-c or d-c circuits, 600-volt rating, it's recommended for d-c circuits in wet locations and for temperature ranges to 75C. Rugged Okoseal jacket is moisture and flame resistant, provides a smooth surface for easy pulling.

To meet the trend toward lighter, more compact control systems in industry and utilities, Okonite now introduces P-30, a superior quality, small diameter, all-thermoplastic control cable. It's an ideal lightweight, general purpose cable for all types of installations—conduit, aerial, duct, tray, direct burial . . . in wet or dry locations.

Over 30% smaller and lighter than conventional-size rubber cables, Okonite P-30 nevertheless provides the kind of performance normally associated with many larger diameter cables. The multi-wall construction of P-30 offers three-fold electrical protection, since both the two protective coverings and the basic insulation are high quality dielectrics.

P-30 is especially suited for use under rigorous conditions. Double-wall construction provides excellent resistance to the chemical attacks of oils, acids, alkalies and other materials. The protective jacket of Okoseal—extruded over the cable assembly—assures a moisture- and flame-resistant covering.

Another example of Okonite *Cable'bility** in action . . . P-30 is designed to give years of trouble-free service on vital installations. For complete details, write for Bulletin 1140, The Okonite Company, Subsidiary of Kennecott Copper Corporation, Dept. EC Passaic, New Jersey. 7963

*Okonite Cable'bility... Cable Craftsmanship since 1878.

where there's electrical power . . . there's

OKONITE CABLE

THREE *e*'s in

Vega?

COUNT 'EM!

*e*FFICIENCY

The new, modern design of the VEGA plus the excellent qualities of the semi-gloss baked-on enamel finish with a reflectance factor of approx. 86% produce lighting efficiency of the highest caliber.

*e*CONOMY

Crisp, trim lines plus deluxe, quality features and true versatility make the VEGA's value unequalled in its moderately-priced class of surface mounted fluorescent fixtures.

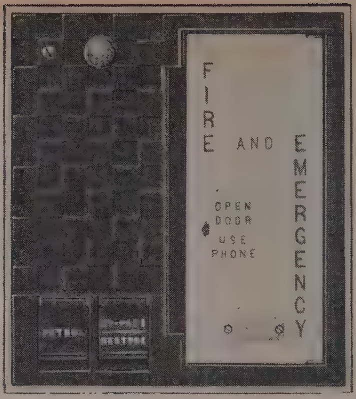
*e*YE-APPEAL

Shallow 3½'' depth. Choice of four diffusers: "Starlite Prismatic" or formed polystyrene, plastic eggcrate or Albalite Pattern #93. Available in 12, 18, 24 and 48" widths.

WRITE TODAY FOR FULL DETAILS AND CATALOG SHEET

Sold Only Through Qualified Electrical Distributors

METALCRAFT
PRODUCTS CO., INC.
6225 State Rd., Phila. 35, Pa.



Alarm Station **(37)**

Proprietary systems for property protection provide 24-hour-a-day emergency, alarm, watch and communications service. During the working day, accidents, fires and other emergencies can be signaled from key locations throughout the premises. During non-production hours, patrolmen keep in touch with security center at regular intervals and are never far from a patrol station. The new Type TFW3B station provides the important features used in such security systems. Face plate is traditional "fire alarm" red and white for visibility and identification. Face plate extends ⅜ in. beyond wall surface. Functions include: fire alarm, patrol report, emergency, guard call and communications.

The Autocall Company, Shelby, Ohio.

Tool **(38)**

An improved Shur-Set R-450 hammer-in fastening tool designed to meet the need of contractors in more rugged hammer-in work. Handle of tool extends from barrel, away from striking surface. Handle also enables workmen to set fasteners more easily in hard-to-reach places such as the limited space between conduit and electrical switch boxes.

Ramset Fastening System, Olin Mathieson Chemical Corp., 460 Park Ave. New York 22, N. Y.

Heaters **(39)**

A new series of electric unit heaters has been added to the Chromalox heater line. Designated type LUH, they are designed to solve space heating problems in factories, public buildings, stores, garages, etc. Heaters have metal sheath Chromalox Finetube electric elements with built-in line voltage overheat protection. Fan motor is totally enclosed and also has built-in thermal overload protection. A junction box is located on top of Bonderite-treated heater housing shell for connection from overhead wiring. Adjustable, horizontal louvers give positive control of air flow in desired direction. Ceiling mounting is accomplished by rod-type hangers. Swivel-type wall mounting brackets are optional. A wide selection of models offer heating capacities ranging from 17,065 Btu/hr to 85,325 Btu/hr. Power capacities range from 5 kw to 25 kw and 208 to 480 volts. Bulletin F14100 is available.

Edwin L. Wiegand Company, 7500 Thomas Blvd., Pittsburgh 8, Pa.

Saw **(40)**

A new super-duty 10-in. saw, model 860, weighs 17½ lbs and will cut 2¾-in. stock at 90°, up to $2\frac{13}{16}$-in. stock at 45°. A feature is floating guards. As cutting depth decreases, upper guard automatically rotates forward and lower guard rotates back. The 115-volt motor is rated at 14 amps. Overall length is 14 in. Handle is contoured for positive control.

Skil Corporation, 5033 *Elston Ave., Chicago* 30, *Ill.*

Transformer **(41)**

New 200- and 400-amp, 600-volt transformers have been designed for greater convenience in low voltage metering. Size of units are 4 by 4 by 2⅝ in. Type CH6 is an outdoor class current transformer with hermetic sealed core and coil. The 1⅝-in. diameter center hole will accept two No. 4/0 copper type RH, RW or RHW conductors. Units are available either for outdoor or indoor use. Outdoor model, CH6-2, has a 600-volt, 200-amp primary, 5-amp secondary unit with a ratio of 40/1 core with coil completely encased in plastic. Model CH6-4 is similar to CH6-2 but with 400-amp primary and 80/1 core ratio. Indoor type is a cased unit but not hermetically sealed. Model CO6-2 is a 600-volt, 200-amp primary with 5-amp secondary. Its ratio is 40/1 and is in a nylon case. Model CO6-4 is similar to the CO6-2 but has a 500-amp primary with an 80/1 ratio.

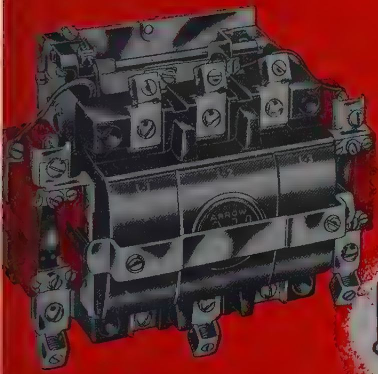
General Magnetics, Inc., 2641 Louisiana Ave. S., Minneapolis 26, Minn.

ANNOUNCING

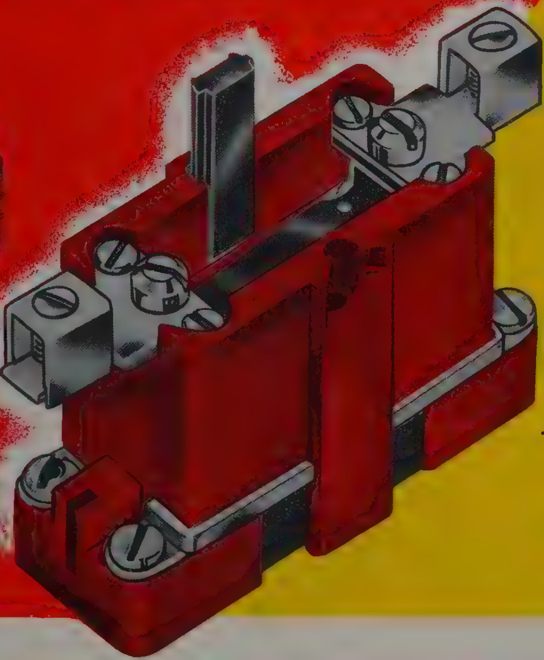
Something NEW under the sun

the ARROW AH HART

AMBIENT COMPENSATED OVERLOAD RELAY



FOR ALL
ARROW-HART
MAGNETIC
STARTERS . . .
NEMA SIZES
0 THROUGH 5!



COMPENSATES
FOR BOTH HEAT
AND COLD FROM
-20°F to 165°F

RELIABLE AND ACCURATE PROTECTION REGARDLESS OF HEAT OR COLD

Here, for the first time, is a compact overload relay that compensates for both heat and cold, operating on the same time curve at all temperatures from -20°F to 165°F. Compensation is completely automatic. No field adjustment is needed. Operating mechanism is simple, rugged and dependable.

This performance is made possible by the exclusive Arrow-Hart "Balancing Bi-Metal" which is located in a separate compartment and is not; therefore, affected by heat applied to the working bi-metal.

- **MUCH SMALLER SIZE** . . . than any other comparable unit now available. Base size is the same as standard A-H Overload Relays.
- **USES STANDARD HEATERS** . . . and works equally well with either quick-trip or regular type.
- **COMPENSATES AUTOMATICALLY** for both heat or cold, by means of an exclusive, "Balancing Bi-Metal" Effective through a temperature range from —20°F to 165°F.
- **DEPENDABLE IN OPERATION** . . . and requires no adjustments of any kind.
- **AVAILABLE** . . . with all A-H Starters. Ratings from 25 to 300 amperes, continuous current. Normally supplied with manual reset. If desired, relays can be equipped with a change-over lever that provides manual or automatic reset, as required.

IDEAL FOR USE . . .

OUTDOORS . . . in oil fields and other installations subjected to wide seasonal or daily changes in ambient temperatures.

INDOORS . . . for control installations located near boilers, furnaces, heating units or refrigeration equipment and subjected to wide daily changes in ambient temperature.

SEE NEXT PAGE FOR CONSTRUCTION DETAILS and ADDITIONAL DATA . . .

THE ARROW-HART & HEGEMAN ELECTRIC CO., HARTFORD 6, CONNECTICUT

AMBIENT COMPENSATED OVERLOAD RELAYS

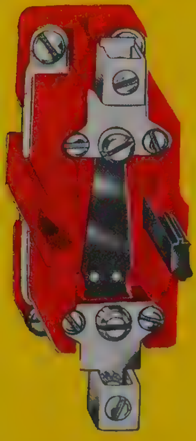
WITH "BALANCING BI-METAL"

DEPENDABLE, AUTOMATIC COMPENSATION for A WIDE RANGE OF TEMPERATURE CHANGES

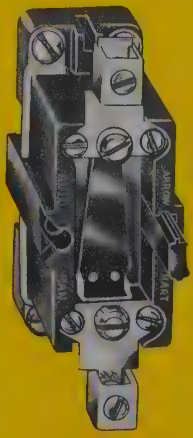
As shown in the accompanying drawing, the working bi-metal and the compensating bi-metal are identical in size and construction and are joined by a coupling bar. As the ambient temperature rises above 72°F, the compensating bi-metal operates through the coupling bar to move the working bi-metal in order to maintain its distance from the trip arm. Similarly, as the ambient temperature falls below 72°F, the compensating bi-metal operates to maintain its distance from the trip arm. Therefore, tripping time remains the same regardless of temperature. Switching mechanism itself employs the same positive snap-action featured in all Arrow-Hart Overload Relays. The calibrating screw permits precise setting. This screw is set and sealed at the factory and requires no further adjustment.

SEND NOW FOR COMPLETE INFORMATION

COMPARABLE IN SIZE TO STANDARD ARROW-HART O.L. RELAYS



New Ambient Compensated O.L. Relay

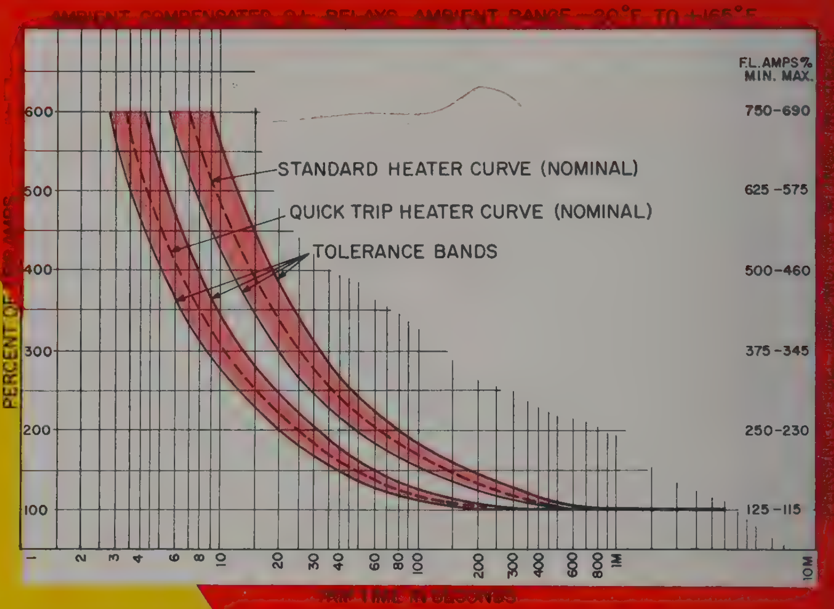


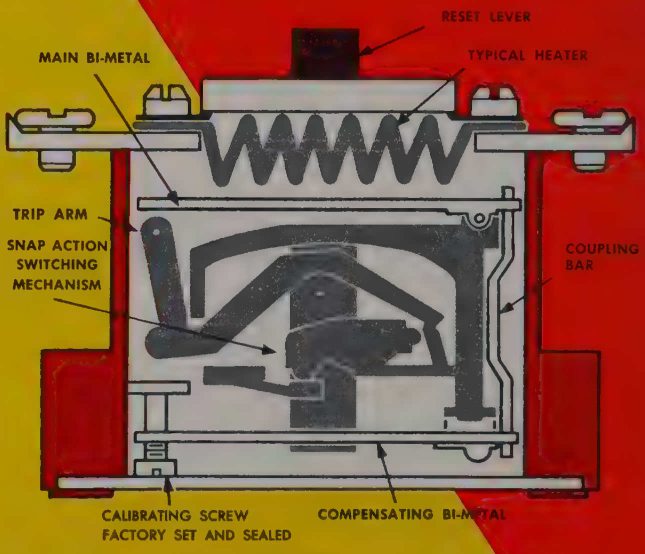
Standard O.L. Relay

THE ARROW-HART & HEGEMAN ELECTRIC COMPANY
103 Hawthorn Street, Hartford 6, Connecticut
MOTOR CONTROL DIVISION

Please send me complete information on the new Arrow-Hart Ambient Compensated Overload Relays with exclusive "Balancing Bi-Metal" Mechanism.

name ______________________________
position ______________________________
company ______________________________
co. address ______________________________
city ______________ zone ______ state ______________





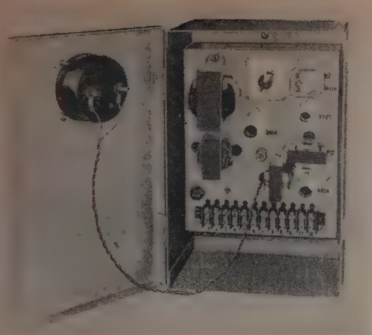
PATENT NO. 2,908,786

OPERATES ON THE SAME TIME CURVE AT ALL TEMPERATURES FROM —20° F TO 165° F!

ARROW AH HART

Quality since 1890

MOTOR CONTROLS · ENCLOSED SWITCHES
APPLIANCE SWITCHES · WIRING DEVICES



Control (42)

Bulletin 5108 PyroTemp, photoelectric temperature-control line, is a temperature-limiting device for controlling industrial heating processes. Unit will control temperature of moving parts or continuous strip, count-heated workpieces, control automatic quenching, and control induction or resistance heaters. Features include: has lead-sulphide photocells; plug-in output relay is thyratron controlled; uses industrial tubes; has an adjustable-potentiometer, temperature-level control. PyroTemp functions by measuring infrared radiation. The pickup, with an infrared sensitive photocell, is aimed at heated surface. An amplifier, temperature-selection dial, and output relay is housed in separate control unit. When temperature of heated workpiece exceeds that of pre-set level, relay operates. Ambient operating temperature range for control and pickups is 0 to 100 F. Power supply is 105-125 volts, 60 cycles. Current input is 0.35 amp.

Clark Controller Co., 1146 *E.* 152*d St., Cleveland* 10, *Ohio.*

Furnace (43)

An improved line of electric furnaces is available in outputs of 62,000 and 82,000 Btu per hour at 240 volts. Both units are designed for easy adaptation to complete year 'round climate control. The 62,000 Btu/hr furnace utilizes four 4½-kw heating elements which are energized and de-energized at timed intervals under thermostat command. This provides modulated heat with accurate temperature control for entire home. The 82,000 Btu/hr furnace has four 6-kw elements. Furnace capacities can be varied in the field to suit individual heating requirements. Furnaces measure 41 in. long, 28¼ in. wide and 22¾ in. high.

Mueller Climatrol, Division of Worthington, 2005 *W. Oklahoma Ave., Milwaukee* 1, *Wis.*

Controller (44)

A low-cost thermocouple-operated potentiometer controller for industrial and laboratory heating operations has been introduced. System is designed for a wide variety of temperature control operations. Heart of system is a transistorized amplifier-relay panel containing all necessary operating controls and circuitry. Panel is constructed of heavy-gauge metal and is corrosion and vibration-resistant. Temperature adjustments are made by turning a dial on the cover of the 9- by 10-in. panel. The non-indicating controller includes a built-in time proportioning unit.

Minneapolis-Honeywell, Control Devices Div., 2753 *Fourth Avenue South, Minneapolis* 9, *Minn.*

Bracket (45)

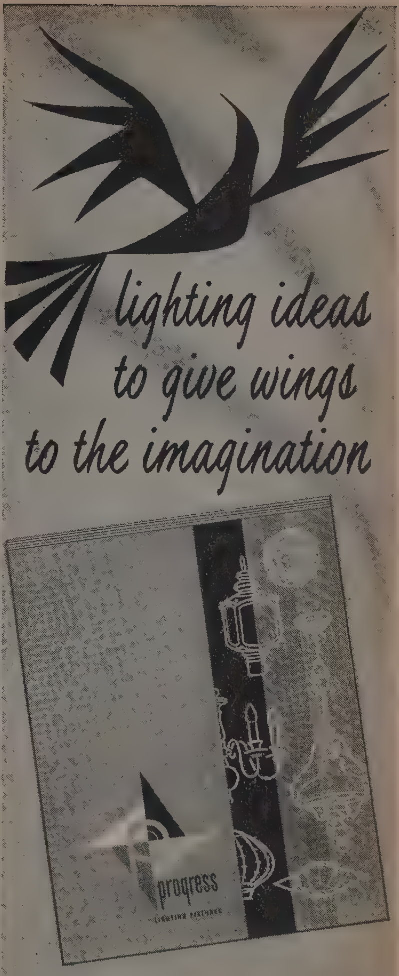
A wooden pole and cross arm accessory mounting has been introduced for the Lamplighter Series 15,000 photoelectric lighting control. The two-piece cast aluminum alloy mounting consists of a right angle bracket and a round receptacle housing. Housing conforms to EEI-NEMA standards for twist-lock receptacle and provides full 360° orientation for a photoelectric control. Right angle bracket has holes for lag-screw or other convenient mounting arrangements. New accessory, which can be used to mount Lamplighter on any vertical flat surface such as a brick wall, wooden pole or cross arm, has an over-all height of 7½ in. Bracket measures 5 in. from bottom to right angle, and receptacle head measures 2½ in. high and 2½ in. across top.

Acme Wire Company, Utility Products Div., New Haven 14, *Conn.*

Lampholders (46)

A new type of pull mechanism is featured in two new porcelain pull lampholders with outlets. Both are for use on 4 in. boxes; lampholder No. 35 with 3-wire grounding outlet and No. 36 with regular parallel slot outlet. New mechanism uses a conical spring instead of a helical spring which permits it to "float" in contact. They have a special alloy contact shell and are fully supported around lamp aperture for insertion of lamps. Dust covers are permanently attached.

Pass & Seymour, Inc., Solvay Station, Syracuse 9, *N. Y.*



60 PAGES IN FULL COLOR

This new lighting fixture catalog instructs, intrigues and excites — even as it displays a product line of unmatched breadth of selection and ability to satisfy a particular need. Budget-priced favorites and superb decorator luminaires alike are found on these pages . . . as are dimming and photo-electric light controls; a complete range of pendants and pulldowns, posts and lanterns; fluorescent and recess lighting. Profusely and handsomely illustrated in full color . . . descriptions that are informative and action-provoking. This happy combination of merchandise, artistry and text adds up to a catalog that will be a delightful source of reference for all home decorators.

• •

PROGRESS MANUFACTURING CO., INC.
ECM-11 Philadelphia 34, Pa.

Please send me________FREE copy(s) of your new No. 105 Catalog.

Name______________________________

Company___________________________

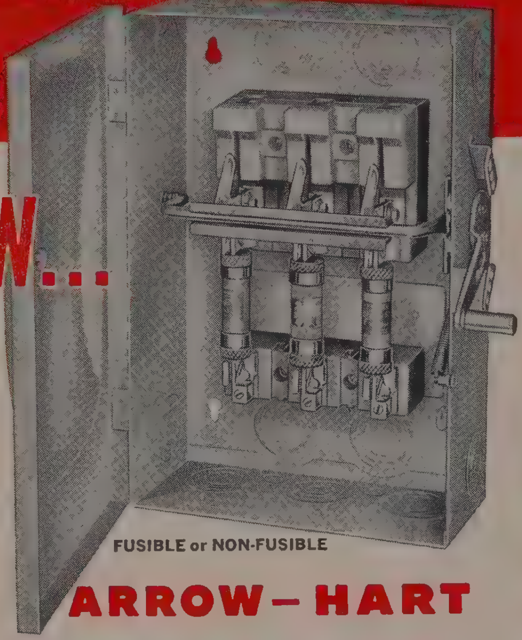
Address____________________________ 10

PERFORMANCE

PLUS

PROTECTION

NEW...



240, 480
and 600
VAC

250 VDC

FUSIBLE or NON-FUSIBLE

ARROW—HART

100 AMP HEAVY DUTY SAFETY SWITCH

For Commercial and Industrial Installations . . . these new switches are designed for safe operation, dependable performance, and provide positive protection for the user. Design and construction features include:

VISIBLE BLADES . . . show at a glance the switch is in the "OFF" or open position.

DEAD-SAFE DESIGN . . . switch cannot be operated when cover is open.

INTERLOCKING INDICATING COVER . . . can only be opened when switch is in "OFF" position.

QUALITY CONSTRUCTION . . . with knife blade contacts and all current-carrying parts silver plated.

COMPACT DESIGN . . . providing maximum wiring space in gutters.

Supplied with NEMA I (General Duty) enclosure. Available with 2, 3 or 4 poles. Write for details to The Arrow-Hart & Hegeman Electric Co., Dept. ECM, 103 Hawthorn St., Hartford 6, Conn.

ARROW AH HART

Quality since 1890

ENCLOSED SWITCHES • WIRING DEVICES
MOTOR CONTROLS • APPLIANCE SWITCHES

ARROW AH HART

Battery Charger (47)

Two new models of lead-acid, motor-generator battery chargers designed specifically for charging motorized hand-truck batteries, the PCL-20S and PCL-6S respectively, charge 20 and 6-cell batteries having a 300- to 450-amp-hour charging rate. Designed to conform to ITA standards, chargers are protected against excessive output currents, motoring due to wrong polarity battery connection or power failure, and charger damage from generator overload or single phasing of the power supply. An exclusive cell thermostat for inserting right into battery cell is offered. Reacting to overload, the thermostat cuts the charger off the line if cell temperature rises too high and starts it again when cell temperature returns to a safe level.

Lincoln Electric Company, Cleveland 17, Ohio

Ladder (48)

A new line of all steel rolling step platforms designed for mobility with stability. The line features a flared base on all models, and a caster locking device on the 6-ft through 12-ft models. The locking device automatically locks ladder to floor when user first steps on ladder. One through five step models are equipped with spring-loaded casters as standard equipment. They are available for working heights to 15 ft with safety treads of expanded metal or non-slip rubber or anti-skid grating.

Louisville Ladder Co., 1101 *West Oak St., Louisville, Ky.*

Thermostat (49)

A new Click Dial electric heat thermostat with built-in thermometer. Designated as Type 800A, single pole, and 800B, 2-pole, the wall thermostat offers all features of original Click Dial thermostat. The "click dial" feature permits precise adjustment of temperature. Other features include: "straight-in" wiring terminals, no heat dial setting, a removable decorator panel. Thermostat has a range of 40° to 84° F, and a mechanical differential of $\frac{1}{2}$° R. It is rated at 22 amps at 120 or 240 volts ac, 2500 watts, at 120 volts ac, 5000 watts, at 240 volts ac, 19 amps at 277 volts ac, 5000 watts. Designed for flush mounting on standard 2 in. by 3 in. wall box. Bulletin 3205 is available.

Penn Controls, Inc., Goshen, Ind.

Product Briefs

(50) A cold-weather vinyl electrical **tape** known as Slipknot "CW" and works at 20° below zero is being marketed by Plymouth Rubber Co., Inc., Canton, Mass. . . . (51) Custom Control & Mfg. Co., Hospital Product Div., Buena Park, Calif., has designed and developed a new ground **detector system.**

(52) Telephone **cabinets** which are 72 in. high and are made from galvanized steel sheets are now being manufactured by General Metals, Inc., Greensboro, N. C. . . . (53) General Electric Co., Schenectady, N. Y., has announced new, higher current ratings in the EJ line of current-limiting **fuses** for short-circuit protection of power transformers.

(54) The new Tele-Tracer wireless **paging system** which speeds messages to key personnel in industrial plants, stores, offices, hospitals, etc., is now being distributed by Standard Research Consultants, Inc., New York, N. Y. . . . (55) Katolight Corp., Mankato, Minn., announces a new 125-kw **generating set** developed for use in industrial plants, institutions, hospitals, and public buildings.

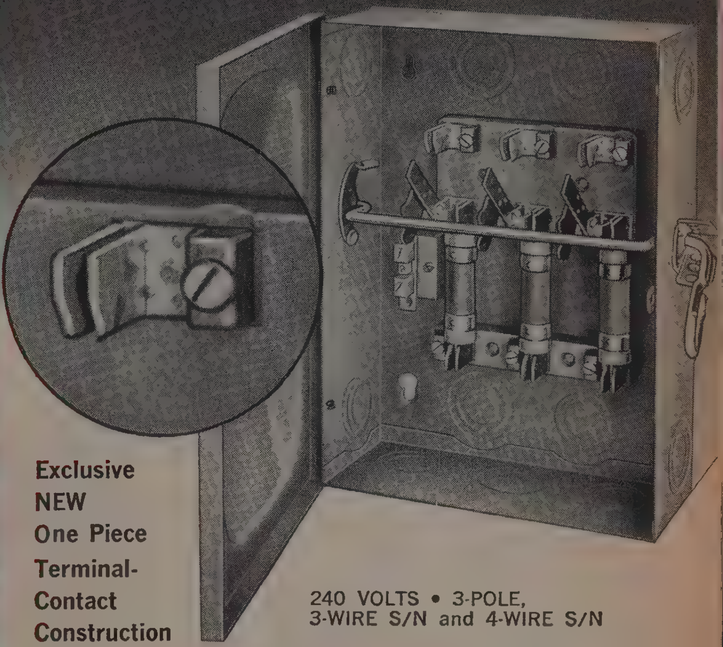
(56) A new brushless frequency **converter** for single-phase drive designed to supply 3-phase, 400-cycle power from a 60-cycle source is announced by Georator Corp., Manassas, Va. . . . (57) Rose Manufacturing Co., Denver, Colo., has developed a **ladder** climber with a rung gripper that attaches to the rung.

(58) New bituminous **fiber conduit** is now being produced by Triangle Conduit & Cable Co., Inc., New Brunswick, N. J. . . . (59) T. B. Wood's Sons Co., Chambersburg, Pa., has announced "Sure-Flex" **spacer couplings** equipped with special detachable hubs that permit the coupling of shafts spread as far apart as 7½ in., depending on coupling size.

(60) A line of pure white **wiring devices** which includes conventional wall switches, outlets and a variety of wall plates, has been introduced by The Bryant Electric Co., Bridgeport, Conn. . . . (61) The Opad Electric Co., New York, N. Y., has announced production of a new portable **ground detector** to indicate leakage and grounds on normally underground power systems.

ARROW AH HART

NEW 100 AMP LIGHT DUTY SAFETY SWITCH



Exclusive
NEW
One Piece
Terminal-
Contact
Construction

240 VOLTS • 3-POLE,
3-WIRE S/N and 4-WIRE S/N

Only 4 Parts Per Pole . . .
Your Assurance of Cool Efficient Operation!

- **STURDY, KNIFE-BLADE CONTACTS . . .** fully visible to provide assurance of safety.
- **EXCLUSIVE CAM MECHANISM . . .** with spring action gives effect of quick make-and-break, insures positive opening and closing of contacts.
- **STURDY, COMPACT, NEMA I ENCLOSURE . . .** has ample knockouts. Extra-wide gutters provide plenty of wiring space.

Write now for complete information. Dept. ECM, The Arrow-Hart & Hegeman Electric Co., 103 Hawthorn St., Hartford 6, Connecticut.

ARROW AH HART
Quality since 1890

ENCLOSED SWITCHES • WIRING DEVICES
MOTOR CONTROLS • APPLIANCE SWITCHES

Count On
ARROLET
Boxes
To Do A
Better Job
-All Around
The House!

When you have to consider quality, time and costs . . . your most profitable choice is Arrolet, for —

SWITCH BOXES
OUTLET BOXES
BOX COVERS
FITTINGS
& RELATED ITEMS

Quality Needed for Tomorrow
is in Arrolet Products . . . *Today!*

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Catalogs, Bulletins and Engineering Data

(62) SYNCHRONOUS MOTORS. Technical characteristics, specifications, ratings and outline dimensions of new Slo-Syn synchronous motors are described in folder SE-L2604, 8 pages. The Superior Electric Co.

(63) INDICATOR LIGHTS are described in two new brochures "Datalites," 8 pages, and "Lights That Enlighten," 4 pages. Dialight Corp.

(64) LIGHTING. Residential and commercial fixtures and brackets with a wide variety of applications are featured in new 8-page catalog. EJS Lighting Corp.

(65) COAXIAL CABLES. An extensive listing of non-R/G coaxial cable construction designed to meet unusual requirements has been compiled. Times Wire and Cable Div., The International Silver Co.

(66) INSULATING MATERIALS. New manual G-65 covers a wide range of subjects on methods and equipment for testing insulating materials. Associated Research, Inc.

JOHN S. VAN ALSTYNE, co-owner and manager, Van Alystne & Sons Electric, Sacramento, Calif., has been named chairman of the 28th annual convention of the Electrical Apparatus Service Association, Inc., which will be held in San Francisco, June 11-14, 1961, at the Jack Tar Hotel.

(67) GENERATORS. Bulletin 700 (A,B) describes full line of ac and dc generators and motor generators. Howell Electric Motors Co.

(68) RELAYS. 8-page booklet "How To Adjust and Maintain Relays" contains detailed instructions with line drawings to correct relay difficulties. P. K. Neuses, Inc.

(69) COMPRESSION connectors and new developments and improvements are described in new brochure. Anderson Electric Corp.

(70) OUTDOOR LIGHTING. New 32-page catalog TP-2 includes photographs, specifications, and dimensions on their entire cast-aluminum line of incandescent and mercury vapor sealed-beam floodlights and clusters, etc. Stonco Electric Products Co.

(71) VOLTAGE REGULATORS are described in a new handbook providing complete specification data for 2,020 standard magnetic voltage regulator models. Raytheon Co.

(72) TEXTILE LIGHTING is the subject of a 12-page publication titled "Higher Profits Through Better Textile Lighting." General Electric Co.

(73) TIMING DEVICES. Engineering bulletin 5903-1 covers line of "DODO" electronic time delay relays. Bulletin 5903-2 describes line of ac operated electronic time-delay relays. Tempo Instrument Inc.

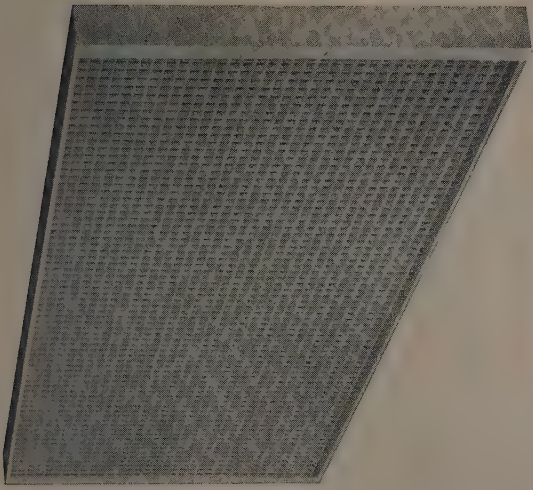
(74) LIGHTING. A new booklet "Glass—Integral Component of Quality Lighting" illustrates the use of glass in several lighting installations. Corning Glass Works.

(75) PARALLEL GROOVE CLAMPS. Technical data and test information on center bolt parallel groove clamps, PAC Series and PAA Series, are contained in data folder 6007. Jasper Blackburn Corp.

(76) CONDUCTORS. 24-page catalog illustrates products in easy to find forms, tables and specifications relating to various kinds of conductors. Ettco Wire and Cable Corp.

(77) LIGHTING PROJECTION EQUIPMENT in copper and aluminum for

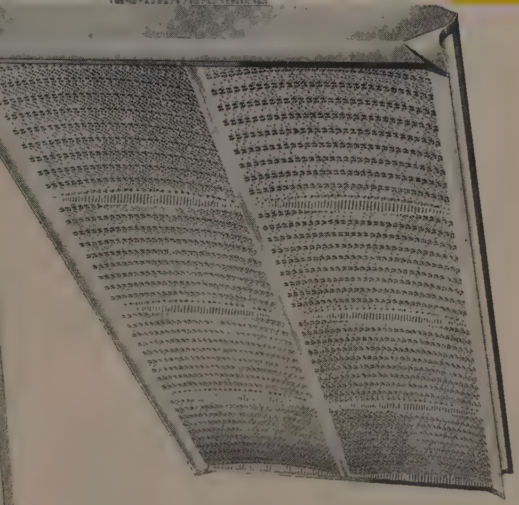
QPLM6500 for thin-lined architectural appeal.



QPCX7400 "Wrap-around" all-plastic enclosure.

QUICK CHANGE LIGHTING

QRH7500 (Sculpturama®) with all-curved styling.



QP8500 (Shallorama®) pioneer in shallow surface-mounted lighting.

Adaptability for future change is a basic design principle in back of Sunbeam Lighting fixtures. For instance, when you specify and install the ultra-shallow, surface-mounted Visionaires® #6500, #7400, #7500 or #8500 you are automatically planning ahead. The diffusers to these versatile series are all interchangeable. They give the building owner a wide choice of 16 different lighting possibilities when planning alterations. He might select QP8500 (Shallorama®) because of its recessed look and wide light distribution, QRH7500 (Sculpturama®) with the sculptured look and which is unexcelled in low brightness control or the QPCX7400 ("Wrap-around") with exclusive SUNLUX® plastic enclosure for soft diffusion. A quick change in lighting is as simple as the unique, tool-free, "hook-on" hinging arrangement can make it. Merely change the framed diffuser!

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Investigate how Sunbeam Lighting today can save tomorrow!

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777 East 14th Place, Los Angeles 21, California — 3840 Georgia Street, Gary, Indiana

ANCHORING AND DRILLING DEVICES FOR FASTENING ANYTHING TO MASONRY

- Economical all around
- Elastic compression absorbs shock, vibration
- Made without plastics: won't wilt with heat, crack from cold
- NOW branded "RAWL", numbered with screw size

SABER-TOOTH drill-n-anchor —DURATHERM heat-treated } drills fast • holds tight

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MASONRY ANCHORS, DRILLS, ACCESSORIES

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CODE INTERPRETATIONS were one of the main subjects discussed at the recent eastern section IAEI meeting at Portsmouth, N. H. Discussing one of these problems are: Francis Waters, electrical inspector, NYBFU, Syracuse, N. Y. (left), and V. E. Klein, fourth vice president of the eastern section IAEI and chief electrical inspector for the Syracuse District of the New York Board of Fire Underwriters (right).

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public, industrial and government facilities is described in catalog and handbook C604. Independent Protection Co., Inc.

(78) ELECTRIC UTILITY bus duct application data is contained in 12-page booklet 30-664. Westinghouse Electric Corp.

(79) INCANDESCENT LIGHTING. 12-page supplement called Cornet Series II describes new addition to series. Jay Lighting Mfg. Co.

(80) MANUAL MOTOR STARTERS. Bulletin GEA-6358C, 12 pages, describes CR101 manual motor starter for fhp motors and CR1062 manual motor starter for integral hp motors up to 7½ hp. General Electric Co.

(81) INDUSTRIAL INCANDESCENT LIGHTING catalog diagrams and describes units for general lighting and specific industrial needs. Benjamin Div., Thomas Industries, Inc.

(82) SPORTSLIGHTING. Bulletin 2721, revised edition, features nearly 100 suggested lighting layouts for sports. Crouse-Hinds Co.

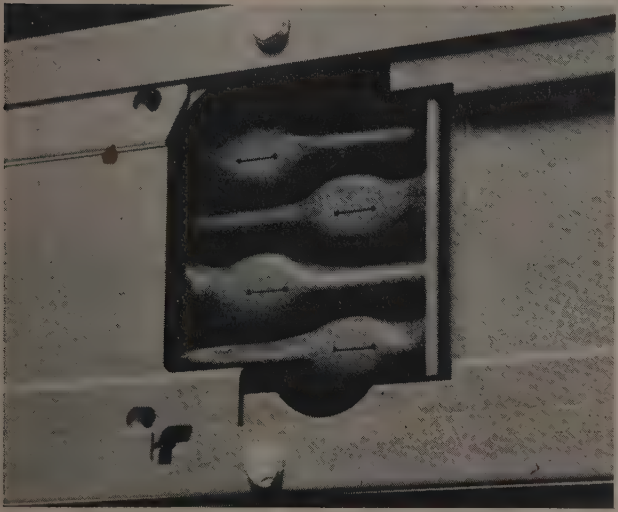
(83) HIGH VOLTAGE TEST EQUIPMENT is described in short-form catalog No. 60. Peschel Electronics, Inc.

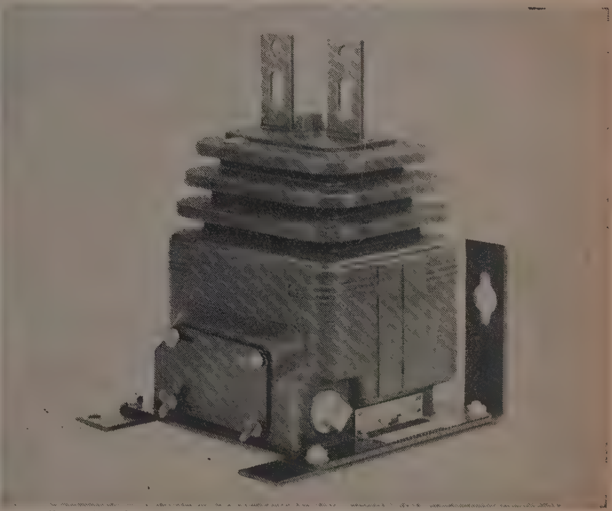
(84) FLOODLIGHTING HANDBOOK covering the selection, specification and installation of floodlights. The Spero Electric Corp.

(85) AVIATION electrical equipment is described in Bulletin 2724 "Lighting and Control Serving

WHAT'S NEWS IN RUBBER

Butyl rubber insulates modern high-voltage transmission lines.


Butyl rubber insulates modern bus duct systems.


Butyl rubber insulates modern high-voltage transformers.

ENJAY BUTYL

best way to handle electricity

Enjay Butyl tops all vulcanizable rubbers in electrical and dielectric properties . . . in resistance to corona and ozone breakdown and water absorption. Its high dielectric strength insures against electric breakdown under normal or surge voltage. Its heat resistance permits higher current flow for a given conductor size. Butyl also offers outstanding resistance to weathering and sunlight . . . chemicals . . . abrasion, tear and flexing . . . superior damping properties ...unmatched impermeability to gases. Result? Butyl is ideal for wire and power cable, transformers, tapes, bus bars, and other insulation applications.

Find out how this versatile rubber can improve your product. Contact the nearest Enjay office. *Home Office:* 15 West 51st Street, New York 19, N.Y. *Other Offices:* Akron • Boston Charlotte • Chicago • Houston • Los Angeles • New Orleans • Plainfield, N. J. • Southfield, Mich. • Tulsa

EXCITING NEW PRODUCTS THROUGH PETRO-CHEMISTRY

ENJAY CHEMICAL COMPANY

A DIVISION OF HUMBLE OIL & REFINING COMPANY

ENJAY
BUTYL

For "fishing" conduit...

WHY USE METAL TAPES?
JET LINE
RIGID ROPE
Replaces Fish Tape
USE IN ANY SIZE, ANY TYPE CONDUIT
JET LINE PRODUCTS, INCORPORATED

USE NEW JET LINE®
NON-CONDUCTIVE
RIGID ROPE*
...safer...speedier...costs less, too!

* Pat. Pending

In any size, any type conduit, fish with Jet Line RIGID ROPE and do away with dangerous metal tapes.

- **Non-conductor — braided poly jacket over solid poly core.**
- **Flexible — easy to push, easy to grip, won't "spring" out of hand, glides smoothly without drag or damage to conduit.**
- **Long-lasting—can't rust, won't separate, strong and durable.**
- **Lightweight—50′ length weighs only 14 oz.**
- **50′ and 100′ lengths — costs less than any fish tape designed for use in all types of conduit.**

"Guide Sleeve" of polyethylene, 12″ length, included—for use in feeding Jet Line RIGID ROPE into outlet boxes.

For full information on RIGID ROPE, and the complete Jet Line Method of wiring conduits, ask your distributor or write

5176

JET LINE PRODUCTS, INC.
615 FUGATE AVE., CHARLOTTE 5, NORTH CAROLINA

WALTER STONE, chief electrical inspector, NY Board of Fire Underwriters, Utica, N. Y., attended the IAEI Eastern Section meeting, recently held in Portsmouth, N. H.

Aviation 24 Hours a Day." Crouse-Hinds Co.

(86) ELECTRIC HEATING. A new "heat computer" with booklet to help in figuring heat loss and cost for electrically heated homes and other buildings. Arvin Industries, Inc.

(87) FLUORESCENT LAMPS. A new booklet entitled "Introducing High-Efficiency Fluorescent Lamps," presents technical data and suggests applications for the new light source. Westinghouse Electric Corp.

(88) SIGNALING EQUIPMENT catalog, Bulletin S-100, 60-pages and three supplements—S-100 C-I, S-100-OEM and S-100 R—includes product descriptions, illustrations, specifications and ordering data. Edwards Co., Inc.

(89) TRANSISTORS. New extensively-transistorized MOTRAC two-

BART F. GREENE, recently retired supervising chief inspector for the Dept. WS G&E, New York City, attended the 36th annual meeting of the IAEI Eastern Section, held at Portsmouth, N. H.

R. A. ROCKFORD, chief construction representative, Consolidated Edison Company of New York, Inc., New York City, attended the recent Eastern Section IAEI meeting at Portsmouth, N. H.

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way radio line is described in brochure. Motorola Inc.

(90) Reduced-Voltage Starters are described in 8-page publication, GEA-6860A; contains a selection and comparison table covering the various types of starters. General Electric Co.

(91) Lightning Safety. New edition of "Lightning Facts and Figures" points up increased need for protection with rules on lightning safety for life and property. Lightning Protection Institute.

(92) Transformers. 24-page publication, GEA-6907A, contains selection and application information on specialty dry-type transformers. General Electric Co.

(93) Building Products catalog is now available which details features of line. Progress Mfg. Co.

(94) Aluminum Boxes. Bulletin 657 describes die-cast-aluminum Pylets which are copper-free, and Bulletin 658 describes standard grade die-cast-aluminum Pylets. The Pyle National Co.

(95) Power Supplies. Bulletin GED-4184, 8 pages, discusses standard line of transistorized dc power supplies. General Electric Co.

(96) Indicator Lights with engineering data and specs of over 30 basic styles are featured in Catalog 120. Control Switch Div., Controls Co. of America.

(97) Speed Control. Color brochure describes Varidyne ac controlled speed systems which provide adjustable speeds on fixed-speed motors. U. S. Electrical Motors Inc.

ROYAL
Quality
for HOME and INDUSTRY
WIRE
Engineered for dependability
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Flexibility that works for you...

...WORKS FASTER AND EASIER ON THE JOB!

Foot-by-foot flexibility of Royal portable cord makes it the easiest handling, fastest working cord you can use on any job. Royal rates *first* among electrical men everywhere because it is quality-controlled to meet *all* the high performance standards you look for in portable cord — safety, flexibility, durability, dependability.

Next time you order flexible cord, specify Royal. Your wholesaler has a complete range of Royal types and sizes — rubber, neoprene, and plastic jacketed cords, power cables, thermostat cable, lamp and fixture wires, machine tool wires, and heavy-duty "POWR-KORD" extensions. Priced right, too!

ROYAL
ELECTRIC
...an associate of ITT

ROYAL ELECTRIC CORPORATION
PAWTUCKET, RHODE ISLAND

Sudden Splash or Soaking Shower

won't stop a Wagner® DP Motor . . .

Wagner® Type DP Motors are doubly protected by rugged, corrosion-resistant cast iron frames and dripproof enclosures. Splashing or falling liquids, corrosive acids, salts, and alkalies can't stop their smooth operation. Designed to meet a wide variety of applications—including many that used to require splashproof motors—Wagner Doubly Protected Motors pack plenty of power into precious little space, are lightweight, long-lived, and pare downtime and upkeep costs to the bone. Simply put . . . they get the job done. Let your nearby Wagner Sales Engineer show you how these motors can be applied to your needs. Call him, or write for Bulletin MU-223.

Wagner Electric Corporation
6413 PLYMOUTH AVE., ST. LOUIS 33, MISSOURI

SLEEVE BEARING MODELS AVAILABLE . . . DP Motors are built in NEMA frame sizes 182 through 445U; 1 through 125 hp—1750 RPM—40°C; available with ball bearing construction as illustrated or steel-backed, babbitt-lined sleeve bearings. Larger motors (Type RP) are available through 1000 hp.

CAN BE RELUBRICATED . . . Original factory lubrication will last for many years in normal service, but openings are provided to permit the relubrication that adds years to motor life under severe conditions.

COOL RUNNING . . . Specially designed baffles direct cooling air through the motor to reduce stator temperature, thus increasing motor life. Blowers, cast as part of the rotor, move large volumes of air without noise or vibration.

WM60-20

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installations, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Motor Insulation Tests

QUESTION L38—Recently we had a failure on a 1000-hp 6000-volt motor that prior to start-up had a Megger reading of 320 megohms. This resulted in a costly rewinding job that we would like to avoid in the future.

Is there an insulation tester on the market that can predict the exact condition of the insulation under all circumstances?—J.A.M.

ANSWER TO L38—The failure may have been due to a breakdown between turns, between phases, or between conductors and the case. No insulation-resistance tester can measure the insulation resistance between turns, since this comparatively high resistance is in parallel with the very low resistance of the windings themselves.

I. R. readings with a high-voltage Megger are advised periodically between the rotor and stator windings and the case, to test the I.R. of each winding to the case. These tests are also advised between phases of the stator windings, after separating the phases at the motor terminal box or the starter, to test the I.R. between phases. It is also suggested that such tests be made before starting the motor after a prolonged stoppage if there is any risk that it may have become damp. Little more can be done by insulation-resistance testing.

It is, of course, possible that the impending failure could not be detected by insulation tests. It might have occurred due to some other cause, such as overload, faulty ventilation, a faulty contact or a supply fault. It might also have resulted from a high-voltage surge due to a switching operation or or lightning. Surge arresters may provide protection against such faults.—J.L.W.

ANSWER TO L38—To my knowledge there is no test equipment on the market that can predict the exact condition of the insulation under all circumstances.

However, I am a firm believer in using the Megger when given the choice of equipment that is available for determining apparent dielectric stress qualities of electrical insulation. No instrument can assure you that the motor insulation will remain stable when the unit is energized even though the Megger revealed a more than safe value for an applied potential of 6000 volts. The basic "rule of thumb" requires that the minimum Megger insulation reading should be at least one megohm per applied 1000 volts potential plus an additional megohm for insurance and taken at normal full-load operating temperature. In this case a reading of seven megohms would seem adequate and despite a reading of 320 megohms, the insulation failed. I suspect though that this reading was taken between winding conductor and motor frame or ground bus and which did not reveal the insulation resistance between the phase belt insulation where different phase conductors occupy the same stator slots. I also suspect that if the motor phase windings had been opened and the Megger applied between all 3-phase windings, it would have indicated dangerously low insulation resistance between phases where high potential differences exist during operation.

Motor winding insulation failure is usually caused by the following factors or combinations: poor workmanship during coil installation; moisture allowed to condense on the coil surfaces; dirt and foreign conductive materials lodging in the crevices and surfaces of the winding ends; atmospheric conditions that are injurious to the insulation qualities; and last but not least, excess lubrication or defective bearing shields allowing grease or oil to infiltrate the windings.

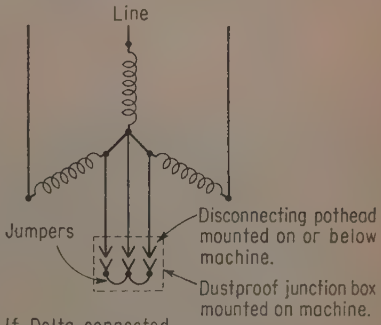
Periodic Megger tests will show up a deteriorating insulation provided records are kept of previous readings, ambient temperatures and atmospheric conditions at each time of test. By use of a reference chart or graph and when the Megger readings begin to show a consistent decrease in insulation resistance, it is time to investigate by taking the unit out of service, opened up, thoroughly cleaned internally, sufficient heat applied to the windings at approximately 175 F. Megger readings are taken until the insulation resistance ceases to climb. Windings are dipped or sprayed with a good quality insulation varnish and heat re-applied until the varnish dries thoroughly. Use these new insulation-resistance readings as a target and although there probably will be some decline after the unit is put in operation, a point will be reached whereby the readings will stabilize under normal conditions and still remain in a safe operating range.

If the motor is "Wye" connected it would more than pay to bring the wye connections out to a disconnecting dummy pothead having the stationary pothead terminals short-circuited to close the wye. If atmospheric conditions are a problem, the pothead could easily be installed in a dust-tight junction box attached to the machine and made easily accessible to qualified personnel—thus periodic Megger testing between phase windings and ground could be performed in a matter of minutes.

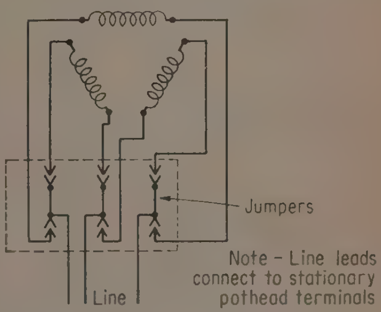
If the motor is delta connected the job could be accomplished with two disconnecting dummy potheads mounted back to back, spacing not too important as all disconnecting operations would only be performed when the motor is secured from the line. (See sketch below.)

If the phase windings are multiplied internally, (that is two or more phase windings in parallel) this

If Wye connected


Line
Jumpers
Disconnecting pothead mounted on or below machine.
Dustproof junction box mounted on machine.

If Delta connected



How Day-Brite lighting helps a school prepare for tomorrow

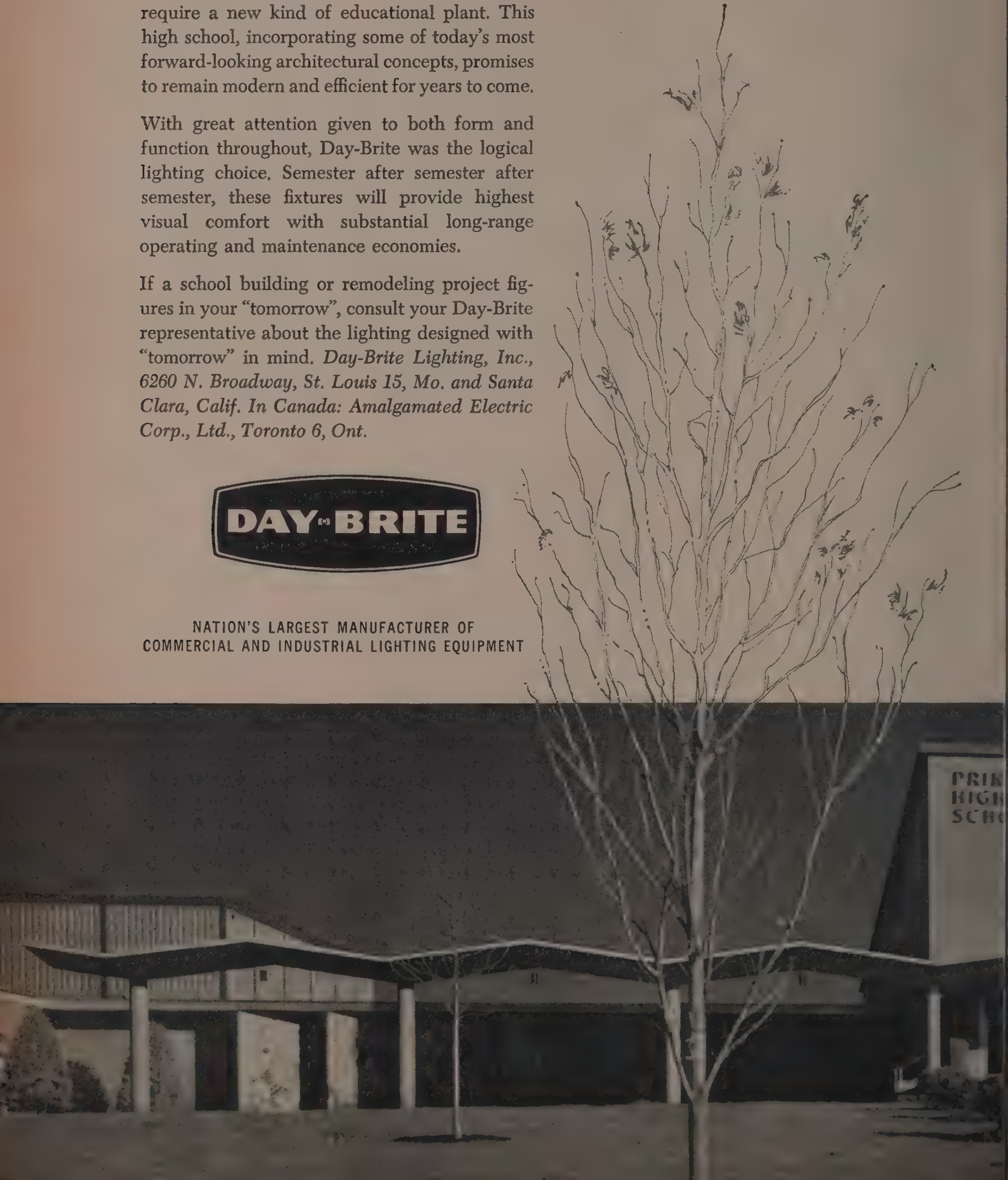
The "little red school house" was fine in its day, but future demands on our educational system require a new kind of educational plant. This high school, incorporating some of today's most forward-looking architectural concepts, promises to remain modern and efficient for years to come.

With great attention given to both form and function throughout, Day-Brite was the logical lighting choice. Semester after semester after semester, these fixtures will provide highest visual comfort with substantial long-range operating and maintenance economies.

If a school building or remodeling project figures in your "tomorrow", consult your Day-Brite representative about the lighting designed with "tomorrow" in mind. *Day-Brite Lighting, Inc., 6260 N. Broadway, St. Louis 15, Mo. and Santa Clara, Calif. In Canada: Amalgamated Electric Corp., Ltd., Toronto 6, Ont.*

DAY-BRITE

NATION'S LARGEST MANUFACTURER OF
COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT



perb Day-Brite Holiday fixtures maintain a minimum lighting level of 70 footcandles.

inceton High School,
tside of Cincinnati

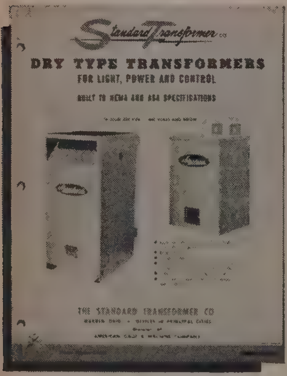
chitect:
tter, Tyler, Martin and Rot.

nsulting Engineer:
sdick and Hilmer

ectrical Contractor:
ltzhoover Electric Co.

Molded acrylic plastic enclosures control light prismatically, eliminating glare.

NEW BULLETIN FREE . . .
Gives weights, sizes and performance features of Standard's dry type line.


Standard Transformer Co.
DRY TYPE TRANSFORMERS
FOR LIGHT, POWER AND CONTROL
BUILT TO NEMA AND ASA SPECIFICATIONS
THE STANDARD TRANSFORMER CO

Standard dry type transformers for light, power and control are designed for service wherever equipment is required in hazardous areas. Most major oil companies use them. Standard's compound fills the entire case, hardens and seals out lint, dust and dirt. They cut noise levels, improve regulation, reduce temperature rise and are lighter in weight and smaller in size.

Get the facts today from your nearby Standard representative or write directly to us.

Standard Transformer CO.

EXpress 2-1563 • WARREN, OHIO
"WHEREVER THERE IS POWER"

could pose a problem as it might not be feasible to bring out all the individual winding paths but would certainly bear investigating when considering the expense to repair a 1000 hp unit.

Last but not least is the quality of insulation, a mute question indeed, especially if the motor insulation is aged. Motor manufacturers try to limit "turn-to-turn" voltage difference potential to a minimum and endeavor to provide the maximum allowable insulation around and between each conductor. Good housekeeping on the part of maintenance personnel to retain clean, dry, and impervious coil belt insulation coupled with stable, allowable operating temperatures should minimize premature insulation aging and promote satisfactory prolonged service.

Also, it is assumed that the strip heater circuit is checked to make certain that heat is applied when the motor is secured to insure that no moisture be allowed to collect among the internal windings. If this is not the case, it is certainly recommended. To prevent a costly burnout it would pay to have the heater circuit checked each time the unit is secured from the line especially if left secured overnight or longer periods. An inexpensive ammeter could be installed in one leg of the heater circuit as a visual indicator to the operating personnel that the circuit is closed and the heat applied.—N.H.P.

Car Braking Methods

QUESTION M38—We are designing a counter-balanced hoist on the escarpment of the Cumberland Plateau to lower quarried quartzite stone to valley level where it will be machine cut into building shapes and sizes.

Since the loaded car will require considerable braking to maintain safe speeds on the 55% grade, we are exploring the possibilities of electric braking on the 300 hp, 2300-volt, 3-phase, ac motor by either one of the conventional methods; such as, dc dynamic braking, capacitor braking, regenerative braking, or by the not too successful plugging method.

We are informed on the handicaps of the latter with the serious overheating of the resistor banks and the subsequent early deterioration thereof. Then too, if you will observe the diagram, it is obvious that if power is not disconnected from the motor as it reaches zero

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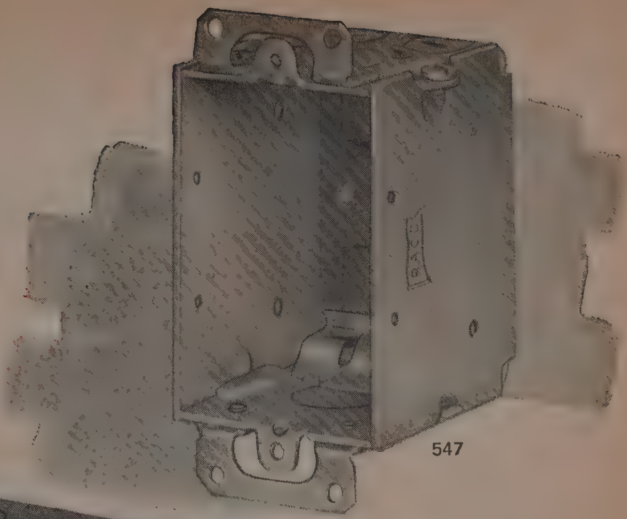

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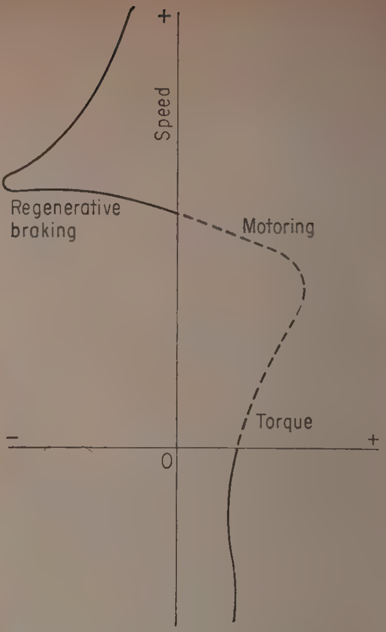
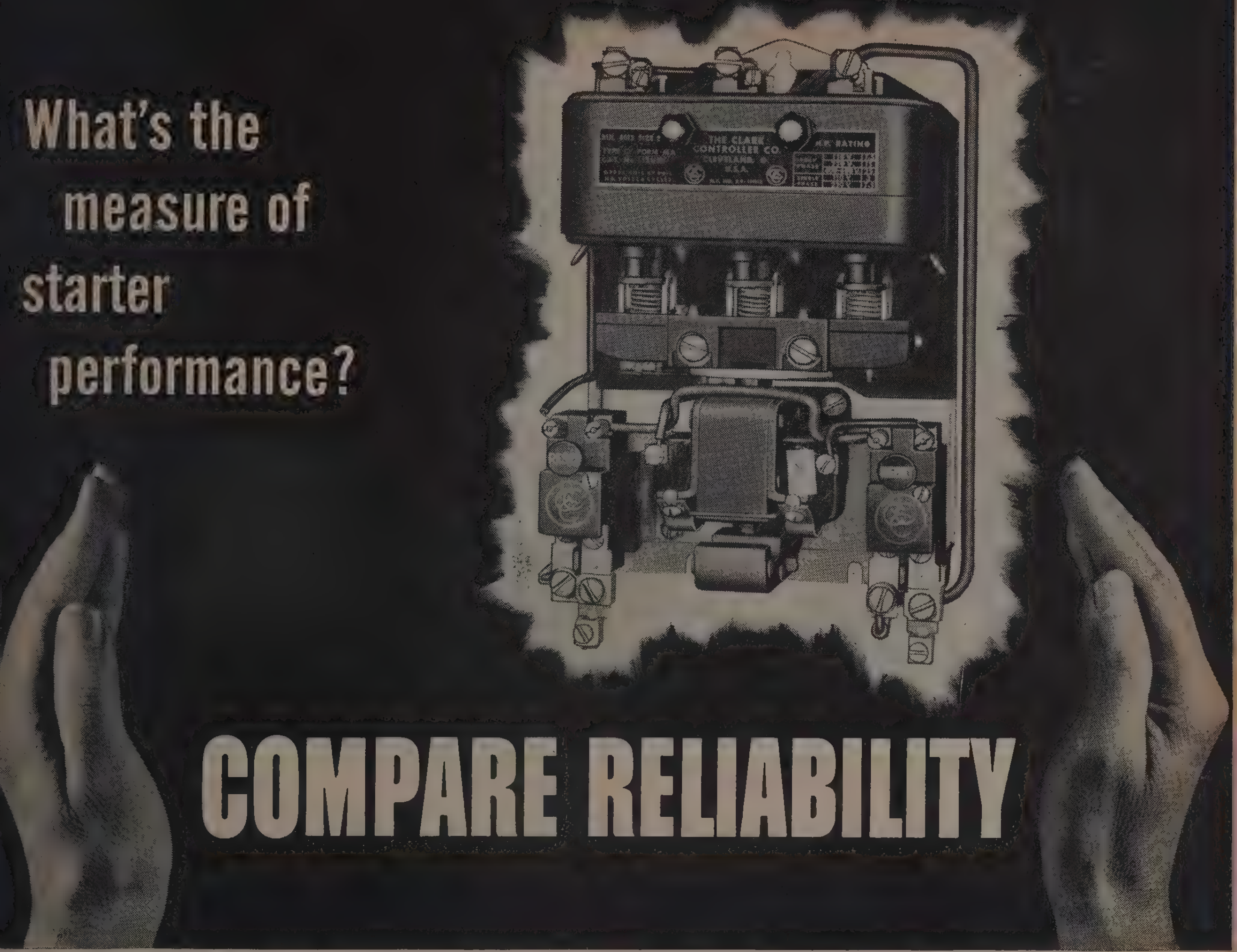


speed, the motor will accelerate up to the synchronous speed in the reverse direction. This means the hoist engineer is relied on to cut off power at the critical moment, unless some automatic means can be provided such as a zero speed switch.

It is suspected too, that the motor has high losses when operating in the plugged position of the controller. It is estimated that such losses may total up to thrice normal values as plugging to a stop is achieved in comparison to those of accelerating from zero to synchronous speed.

It will be appreciated if experienced mine power men will elaborate for us on the advisability of using regenerative braking with the thought of reducing our monthly billing to some small degree without risking early replacement of the resistor banks through overheating, plus the hazard of flashovers across the slip rings in the inadvertent instances of overspeeding.—W.W

ANSWER TO M38—Although plugging is by far the most popular method of braking motors, you are correct in your belief that it is extremely wasteful of energy and of course it does impose a severe load on the secondary resistors. The danger of a motor reversing after being plugged to a stop may be eliminated through the use of a zero speed switch, which will open the reversing contactor whenever the motor speed reaches zero. There are three types of zero speed switches, friction, magnetic and



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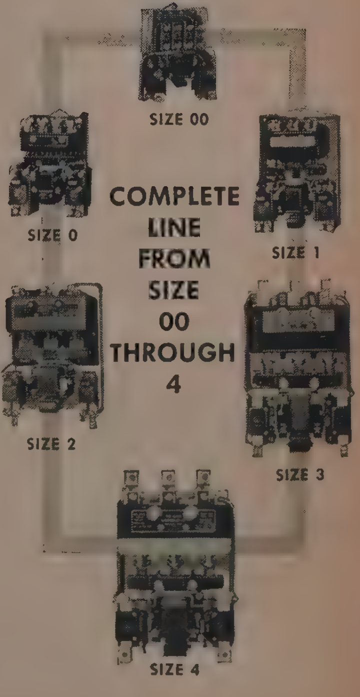

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electric relay. With the friction type a contact is held closed by the friction of a small belt over a pulley being turned by the motor. When the motor speed decreases to zero this belt goes slack, allowing the contacts to open. In the magnetic type a small metallic disk is rotated in a magnetic field supplied by an alnico magnet. Eddy currents set up in the disk cause a separate magnet assembly to turn and hold a set of contacts closed. At zero speed the disk does not turn, hence, there are no eddy currents and the magnet assembly does not turn. Thus the contacts are open and the motor cannot reverse. The electric plugging relay is designed to remain closed until secondary current decreases to the normal inrush value which corresponds to the starting condition or the zero speed value. Any of these devices will prevent motor from running away.

Regenerative braking is only effective for stopping a motor when used on adjustable voltage systems such as a Ward Leonard drive. With a straight ac motor such as yours, regenerative braking will only occur when the motor is being driven above synchronous speed by an overhauling load. Increasing the resistance in the secondary circuits will increase the speed and the motor will still have to be plugged to halt the load. DC dynamic braking is probably the best system. It offers better control than plugging and is more efficient, since only the energy received from the load is absorbed by the secondary resistors. Dynamic braking of an ac induction motor is accomplished by disconnecting it from the line and applying a dc voltage to one of the stator phases. If two-and one-half times as much dc current as normal full-load ac current is supplied, there will be a braking effect equal to approximately 25% of the motor's normal starting torque. With a wound-rotor machine the braking effect may be increased by adding resistance in the secondary circuit. The dynamic braking system will also allow the operator closer control of the load.

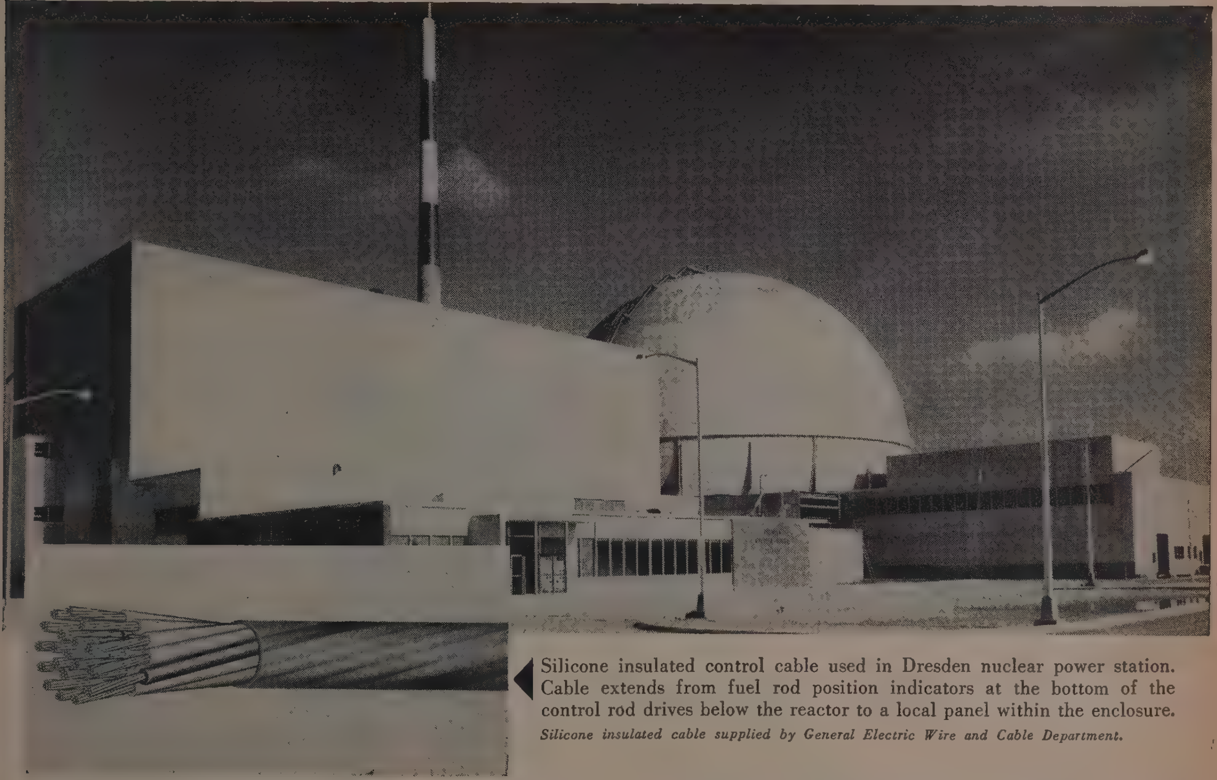
Whether or not the expense of changing to a dynamic braking system is justified will have to be decided by you. Both systems are workable and in general use.—F.W.G.

Voltage Unbalance

QUESTION N38—What percent voltage unbalance can be tolerated on a 3-phase, 240-volt or 480-volt

General Electric Silicone Rubber Insulation chosen for Dresden Nuclear Power Station

Excellent moisture and heat resistance, protection against gamma radiation



Silicone insulated control cable used in Dresden nuclear power station. Cable extends from fuel rod position indicators at the bottom of the control rod drives below the reactor to a local panel within the enclosure.

Silicone insulated cable supplied by General Electric Wire and Cable Department.

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High Ozone Resistance: Ozone and corona, which cause rapid aging of organic rubber, have negligible effect on silicone rubber.

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Radiation Resistance: G-E silicone rubber insulation will withstand gamma radiation up to 1 x 10^8 roentgens, about 20 times higher than fluorine-containing insulation.

For more facts and figures on G-E silicone rubber insulation, write General Electric Company, Silicone Products Department, Section DD1113, Waterford, New York.

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Section DD1113, Silicone Products Department
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1¼" Conduit or Pipe	6⅞"	EMT 8"
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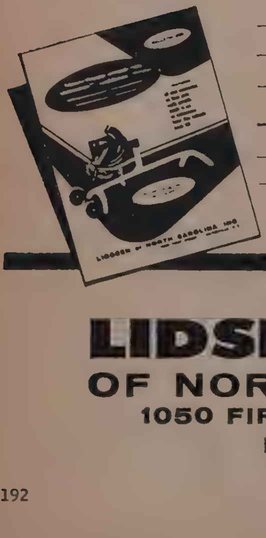

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delta system for 3-phase motor operation? What effect does the voltage unbalance have on the motor winding?—H.H.L.

ANSWER TO N38—This varies with manufacturers but 5% unbalance seems an usual value tolerated.

If current unbalance is present unequal heating may cause some mechanical unbalance with attendant vibration. Unbalance has been due to difference in parts of the magnetic circuit of the stator. If one winding has serious faults in it, the effect on the other circuits is marked and sometimes the vibration may cause mechanical defects to be magnified.—C.O.D.

ANSWER TO N38—The percent of voltage unbalance that can be tolerated on any 3-phase, 240 or 480-volt delta system for 3-phase motor operation is primarily contingent upon the motor load. An unbalanced voltage causes unbalanced currents; therefore, a fully loaded motor can be destroyed by insulation failure due to the heat generated. A lesser evil is noise caused by torque pulsations.

Solution: 1. If practical, correct the unbalance.

2. Use a clamp-on ammeter to check the current in each phase in star connected motors. If not excessive, and noise within reason, it is all right to use.

3. On delta connected motors do not exceed 5% unbalance.—J.A.M.

ANSWER TO N38—Voltage unbalance causes current unbalance in the stator and rotor windings; it tends to cause noisy operation and may reduce the starting torque somewhat. It is likely to have serious results only if it reduces the starting torque below the required value, or if it results in overheating of the heavily loaded parts of the windings. The percentage unbalance, which can be tolerated, therefore, depends on the operating conditions of the motor in each particular case.

Normally up to about 6% unbalance may be tolerable if the motor-circuit cables are reasonably large, so that there is no undue voltage drop in these cables during starting and if the motor is not fully loaded. However, the best plan would be to measure the current in each phase of the stator windings when the motor is running on full load; this should not be allowed to exceed 58% of the rated line current of the motor.—J.L.W.

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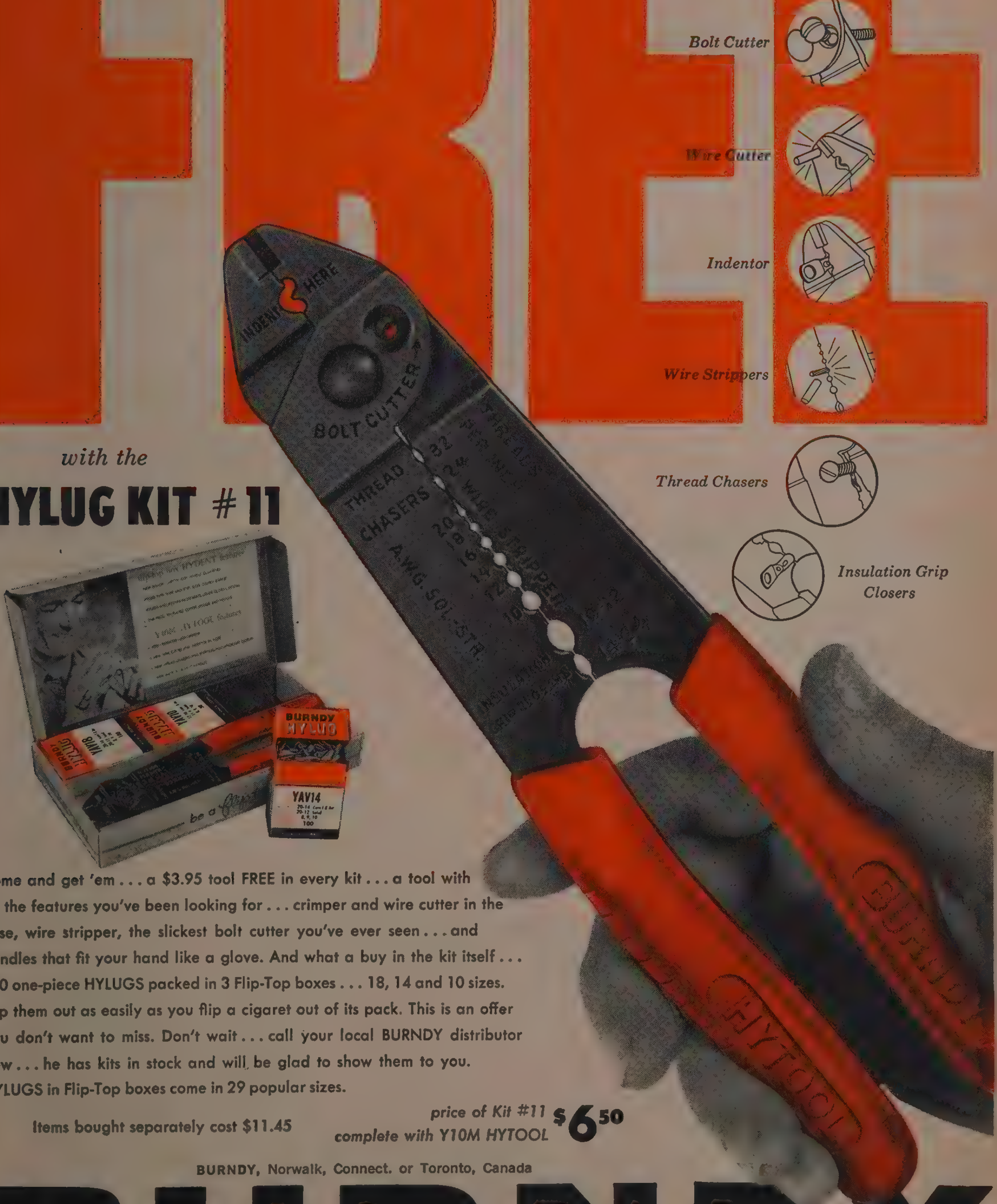

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CAN YOU ANSWER These QUESTIONS?

QUESTION W38—We are in the throes of designing a new research building and need an adequate equipment ground throughout the entire building. This ground should interconnect the structural steel. The questions are: What size copper must be used to ground every column? How is this wire connected to the column? Are ground rods needed at each column?—J.M.

QUESTION X38—Suppose we are planning to add a 1500-kva turbo-unit to our 3000-kva generating equipment, and also wish to install a synchronous condenser to improve our power factor, now only about 70%. What should be the capacity of the exciter to supply both the new generating unit and the condenser?—G.J.P.

QUESTION Y38—I am rather puzzled regarding ratings of air conditioning units which we have on the market in Canada. These units are mostly for installation in windows. According to our technical publications and understanding 1 hp is equal to 2545 Btus per hour. However, I find on the market a 1 hp air conditioner with a rating of 6700 Btus and 7½ amps at 115 volts. What confuses me is 7½ amps; according to Table 41 of the C. E. Code this is very near ½ hp which is rated at 7.4 amps and this would certainly not furnish a 1 hp air conditioner. I find in another case a 1 hp air conditioner with a rating of 8600 Btu and 12 amps at 115 volts. According to CSA a ¾ hp has a rating of 13 amps. Therefore, the rating of this air conditioner must be slightly less than ¾ hp. In making inquiries I am advised that the NEMA rating for 1 hp is 12,000 Btus.

With all these confusing ratings I am certainly at a loss. During my past education I was taught that 1 hp was equal to so many Btus—2545 per hour.

It would be very much appreciated if you would have your readers explain to me how these different ratings are arrived at, or are they simply selling gadgets to the public.—J.S.B.

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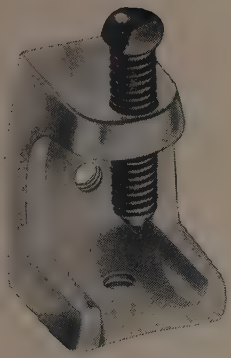

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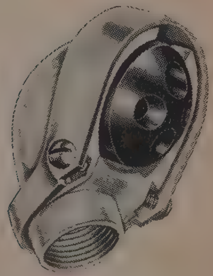

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Questions on the Code

Answered by:

B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*
R. E. WARD, *Chief Electrical Inspector, Insurance Department, State of Tennessee, Nashville, Tenn.*

Wiring Range Components

Q. For the past few years, we have been allowing the normal household electric range, divided unit type, to be wired in two different manners. Lately there has been some difference of opinion as to which system is proper or the best system to use. At rough-in time the brand of range is not known.

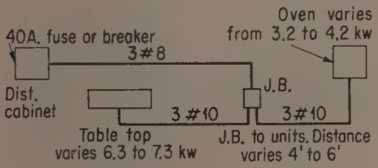
Oven varies from 3.2 to 4.2 kw
40A. fuse or breaker
3#8
J.B.
Dist. cabinet
3 #10
3#10
Table top varies 6.3 to 7.3 kw
J.B. to units. Distance varies 4' to 6'

Fig. 1

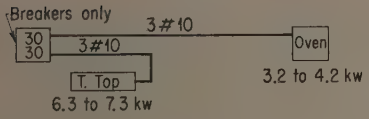

Fig. 2

We would appreciate any comments you would care to make concerning any part of these drawings.—R.F.

A. The wiring diagram shown by Fig. 1 could be criticized on the basis of Section 210-3 of the code which does not recognize a 40-amp branch circuit when more than one appliance is served. It is significant to note in this respect that the provisions of Section 210-24 covering permissible loads on recognized branch circuits does not include a 40-amp branch circuit. As a result, the use of such a circuit would be in violation of code rules. In order to fully satisfy code requirements, a 50-amp branch circuit with No. 6 conductors should be used. The 1940 edition of the code recognized a 35-amp branch circuit and also a 25-amp circuit. Such circuits were deleted in the 1946 Code and replaced with the 30-amp branch circuit. The application shown by your diagram emphasizes the need for code recognition of a 40-amp branch circuit unless additional fixed appliances are involved. On the basis of hazard, a 40-amp branch circuit would provide a higher degree of safety than that provided by a 50-amp branch circuit. Regardless of code rules some inspection authorities have recognized the 40-amp circuit shown for the previously mentioned reason.

The provisions of Section 210-19(c), Exception (2-d), recognize tap conductors to the range components to be no longer than necessary for servicing. It is my opinion that the branch-circuit conductors should be brought direct to each unit, within a foot or two of same. This is the point where the No. 10 tap originates. I doubt that the location of the range components would be such as to permit the use of one junction box as shown on the diagram.

Fig. 2 illustrates a method of procedure which several inspection authorities endorse. In this case, a higher degree of protection is obtained when individual 30-amp branch circuits are used. Independent of one another, a fault on one circuit will not influence the operation of the other. I am unable to agree that breakers only should be used for the branch circuit protection. Compared with a 50-amp branch circuit, the degree of safety is considerably increased when the method of procedure shown by Fig. 2 is used; and until such time as the code recognizes a 40-amp branch circuit, I believe, on the basis of economy and safety that the individual 30-amp branch circuits will be favored by inspectors, and applied by contractors.—B.A.McD.

Editor's Note: In both Figs. 1 and 2, 3 No. 10 conductors are run to a counter-mounted cooking unit, which has varied ratings from 6.3 to 7.3 kw. If the No. 10 conductors are standard Types R, RH or T, they have a maximum current-carrying capacity of 30 amps. And the maximum size unit cooking appliance that can be connected to 30-amp conductors is 6.9 kw (230 by 30), whether the conductors are taps or branch-circuit conductors. See NEC Section 210-19 (c), Exception No. 2; Table 220-5, Note 5; and voltage ratings stated prior to Example 1, Chapter 9, 1959 NEC edition.—J.H.W.—11/60/1

Bare Copper Wire in Aluminum Conduit

Q. Recently I had an installation rejected due to the fact that in an underground service of aluminum conduit I had used a bare neutral copper conductor.

Under what section of the code could such rejection be made?—W.B.R.

A. Actually the rejection could not be made under specific wording of the NEC except under Article 90, Section 7, which states:

"Enforcement. This code is intended to be suitable for mandatory application by governmental bodies exercising legal jurisdiction over electrical installations and for use by insurance inspectors. The administrative authority supervising such enforcement of the code will have the responsibility for making interpretations of the rules, for deciding upon the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules."

You will note from the above that where a question such as yours is raised, with no specific guidance from the NEC, the administrative authority has the right and should use his best knowledge and judgment concerning such problems. Under Article 230-30, Exception No. 2 states "bare grounded neutral conductors of copper may be installed underground in duct or conduit," and, of course, this section pertains to underground services. Therefore, a bare-neutral copper conductor may be used in an underground service, and no mention is made as to the kind of conduit used. Your question has been discussed at many inspectors' meetings, and some clarification of your question is certainly needed. Representatives of aluminum manufacturers do not recommend such an installation as you have outlined, and I am sure the electrical inspector rejecting such job has knowledge of the stand of manufacturers of aluminum on this question. Very interesting reading is outlined in the 1959 proceedings

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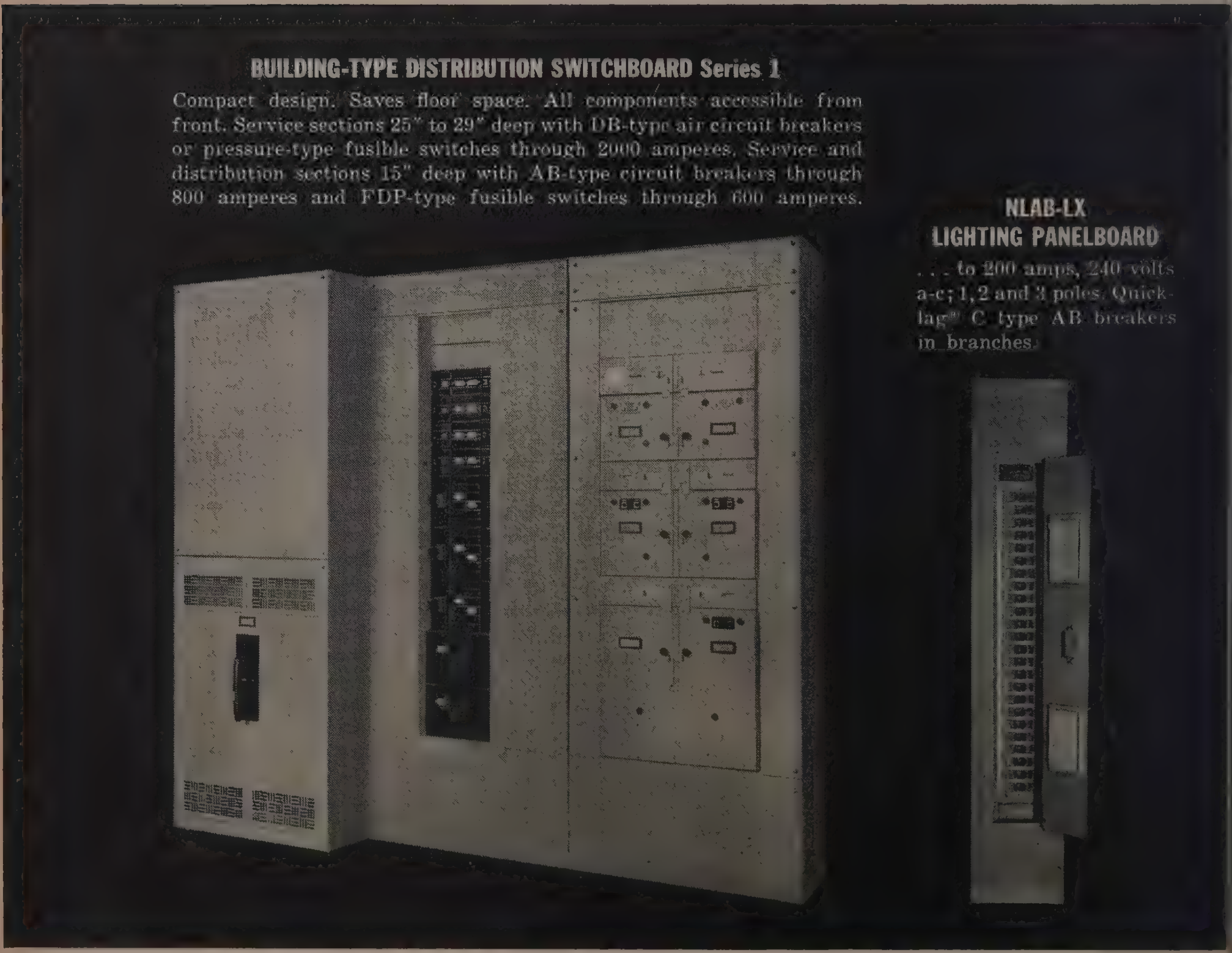

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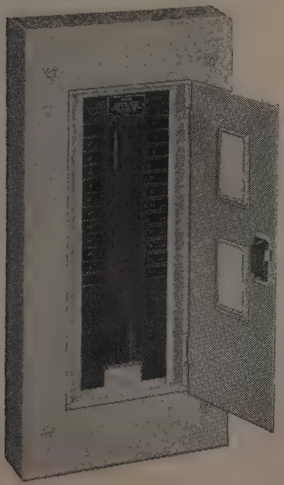

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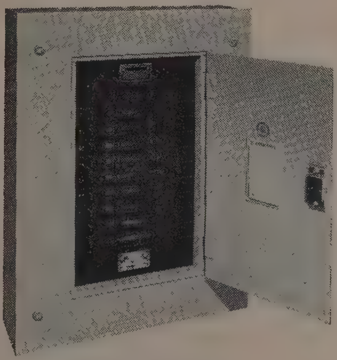

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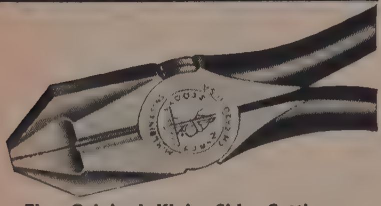

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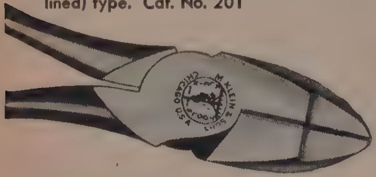

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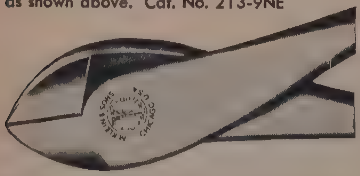

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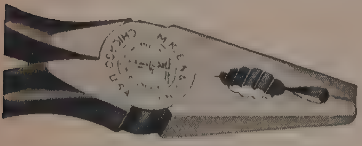

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of the International Association of Electrical Inspectors. Reference is made to one of the proceedings, and I quote a statement attributed to a representative of an aluminum company, who participated in the discussion. The following question was asked:

"Section 230-30 now calls for a bare grounded-neutral conductor to be installed in duct or conduit. As you read it, that would, of course, include aluminum conduit. I have refused the use of a bare copper conductor in aluminum used for underground services. I am sure we would get into trouble. Do you agree on that?"

The answer by the aluminum company engineer was:

"I certainly do agree. Underground bare copper conductor is not a good installation in aluminum conduit. Use an insulated wire such as Type TW for the neutral."—R.E.W.—11/60/2

Conduit Fill Derating Factors

Q. *Are my figures below correct for running two No. 10 TW wires, and three No. 14 wires in conduit?*

No. 10 wire—
0.0460 x 2 = 0.0920 sq in.
No. 14 wire—
0.0327 x 3 = 0.0981
0.1901 sq in.
40% of ½-in. conduit = 0.12 sq in.
40% of ¾-in. conduit = 0.21 sq in.
¾-in. conduit required

Total area of wires at 40% fill would require ¾-in. conduit. This is for new work and the wires are run to a motor (single phase). The three No. 14 wires are control wires. Are the motor control wires to be counted for derating purposes?—R.B.

A. The computations are correct, and a ¾-in. conduit would be required.

Note 8 to Tables 310-12 through 310-15 covers the derating factors which apply when more than three conductors are installed in a raceway. An exception which reads as follows also applies:

"Exception—when conductors of different systems, as provided in Section 300-3, are installed in a common raceway the derating factors shown above apply to the number of power and lighting (Articles 210, 215, 220 and 230) conductors only."

Section 300-3 (d) reads as follows:

"Control, relay and ammeter conductors used in connection with any motor or starter may occupy the same enclosure as the motor circuit conductors." This rule distinguishes a control conductor from a power conductor.

In the case under discussion, we have two power conductors that serve the motor, and three control conductors which govern its operation. They are all installed in one conduit as recognized by Section 300-3 (d). According to the exception quoted above, the derating factors only apply to the two power conductors. As a result the two No. 10 conductors would not be subject to derating. — B.A.McD. — 11/60/3

Clothes Dryer Circuits Reader's Comment

A prominent electrical inspector directs our attention to a code provision which continues to be a source of controversy due to the absence of authoritative advice. His letter is quoted as follows:

"In the March issue of *Electrical Construction and Maintenance*, a question by *J. G. L.* and the answer relative to branch circuits for electric clothes dryers has created some confusion.

"Section 210-23 of the NEC states that the total load shall not exceed 80% of the branch circuit rating if motor-operated appliances are supplied.

"The answer to the question implied that the only problem to consider is whether the dryer would be considered a long continued load of over three hours.

"Two questions are raised by this interpretation:

1—An electric clothes dryer is not considered as a motor-operated appliance, and

2—If this is true, would an electric dishwasher operating at 120 volts with a 10-amp motor running load and a 4-amp heater be permitted on a 15-amp branch circuit?"

Editorial Comment:

Section 210-23 of the code first appeared in the 1946 edition, and the requirements are similar to those provided in the 1940 Code. Abbotts N. E. Code Handbook, based on the 1946 Code, describes the occasion for the rule as follows:

"The rule that the total load on a branch circuit must not exceed 80% of the circuit rating if the circuit supplies a motor has few applications in practice. A possible application would be a case where a

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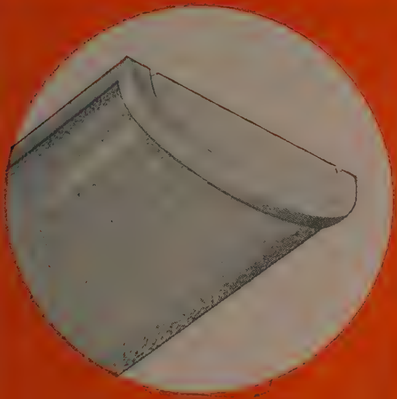

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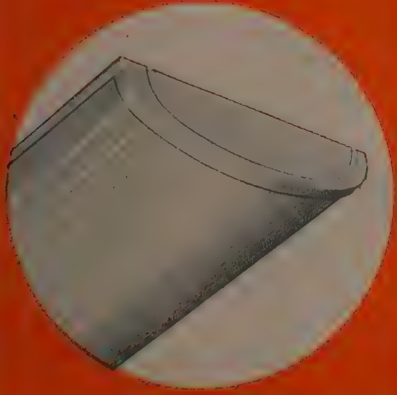

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circuit supplies an attic ventilating fan and some lighting outlets. Assuming the motor to be ¼ hp, a 15-amp circuit used in this manner should be limited to an area where the lighting load will not exceed about 800 watts."

This opinion covers the intent of the rule when it first appeared in the 1946 Code. To me, it infers that the rule concerns a branch circuit serving more than one outlet. As a result, the status of an individual branch circuit which only serves a dryer is questionable. The occasion for the rule, in my opinion, concerns the starting current of the motor and this factor, regardless of intent or wording, should be considered in either application.

What is a motor-operated appliance? In the absence of a definition, one may only speculate, and I am inclined to believe, when this phrase first appeared in the code, that appliances such as washing machines, portable drills, pumps, etc. were visualized. It appears, however, that such motor-operated appliances were limited in size to 6 amps as covered by Section 430-42 subject to the exception of paragraph (b). This concept may be challenged since I question the intent of Section 210-23 when an electric clock, or a vacuum cleaner is connected to a branch circuit. Both are motor-operated appliances, but I see no occasion to derate a branch circuit which serves a motor-operated clock. Should a circuit serving receptacles and light outlets be derated when a fixed 1/30-hp fan, or a small mixing motor is connected to same? I don't believe such was intended but a literal reading of this rule infers such procedure.

What is the status of an appliance which contains a heater, a lamp outlet and a motor? What is the status of an oven containing an electric clock? Are such appliances considered to be motor operated? If so, the derating factor applies.

Our Associate Editor J. H. Watt submits the following opinion with respect to these questions:

"Where do we draw the line when a unit is a motor-operated appliance or not? Many electric heaters contain a fan motor, even some cooking appliances have a small motor. Also dishwashers contain both electric heaters and a motor.

"I have always considered a motor-operated appliance as one in which the motor performs the major operation of the appliance such as air-conditioners, attic fans, circulating pumps, sump pumps, blower motors for oil- or gas-warm-air furnaces, kitchen disposals, vacuum cleaners,

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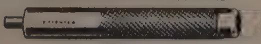

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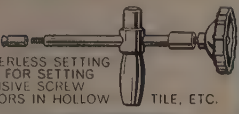

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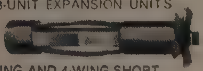
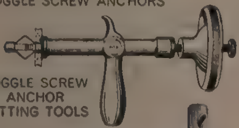
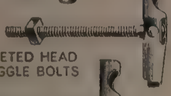


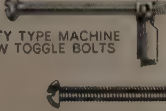
2-WING AND 4-WING SHORT, LONG AND EXTRA LONG TOGGLE SCREW ANCHORS



TOGGLE SCREW ANCHOR SETTING TOOLS

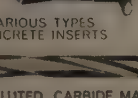


RIVETED HEAD TOGGLE BOLTS



GRAVITY TYPE MACHINE SCREW TOGGLE BOLTS

SPRING WING TOGGLE BOLTS



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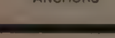

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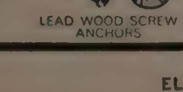

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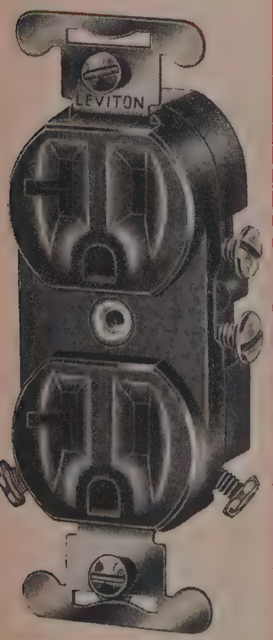

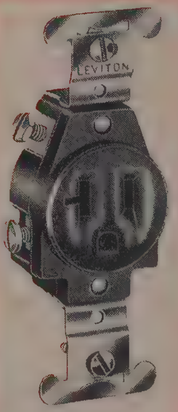

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air compressors, grinders, table saws and similar equipment. However, I have no background of authoritative advice to back up this contention.

"It would seem therefore that the inspector's letter could be used as a basis for an interesting code problem. Also, since the term "motor-operated appliance" is mentioned in several places in the code, it would seem that a proper definition for same would not be unreasonable in Article 100."

Insofar as UL is concerned, clothes dryers are listed under heaters. The major load is a heating load, and in answer to your first question, I am inclined to agree with Mr. Watt that the use of a motor integral with the appliance does not warrant the designation "motor-operated appliance," within the intent of Section 210-23. Reference to American Standard Requirements for Residential Wiring indicates that a 3-wire, 115/230-volt, circuit wired with No. 10 conductors is considered to be adequate for serving an electric clothes dryer. This general statement could be challenged on the basis of the rating of the dryer, the ratio between the heating and motor loads, and the method of operation. Field experience indicates that a UL listed dryer, rated at 26 amps, will function properly on a 30-amp individual branch circuit.

In reply to your second question, the dishwasher load consists of a motor and a heater. The combined load is 14 amps, and the motor load is 71% of the total load. In this case the motor performs the major operation, and it appears that this appliance may properly be called a motor-operated appliance. Regardless of the provisions of Section 210-23, it appears evident that such a dishwasher is not permitted to be served by a 15-amp circuit. Here again the term "motor-operated appliance" creates a fog of dispute which may only be clarified by a code definition. At this point, one may interject the thought that the new provisions of Section 240-4, which requires "Time-Delay Overcurrent Protection" in residential occupancies on circuits of 20 amps or less, would permit the dishwasher in question to function satisfactorily on a 15-amp circuit. This observation is given merely to emphasize the chain of revisions which often occurs when a new rule appears under a specific Article. Will this time-delay rule influence motor rules which have been in the code unchanged for many years?

In the absence of authoritative advice, let us hope that the very interesting questions that have been raised will promote code clarification in the near future.—B.A.McD.

Editor's Note: Since this original comment, we have received several additional letters from inspectors concerning derating of clothes dryer circuits. They indicate that they consider an electric clothes dryer to be a motor-operated appliance, and as such, require the 20% derating called for in Section 210-23 (b). In view of these statements and the opposite views of others, it is increasingly apparent that a code definition of a motor-operated appliance will aid in a more uniform understanding of Section 210-23 (b). At the same time, the need for derating clothes-dryer branch circuits should be considered on its own merit, but not on the basis that a dryer could be tabbed technically as a motor-operated appliance. — J.H.W. — 11/60/4

Motor Branch Circuit Protection

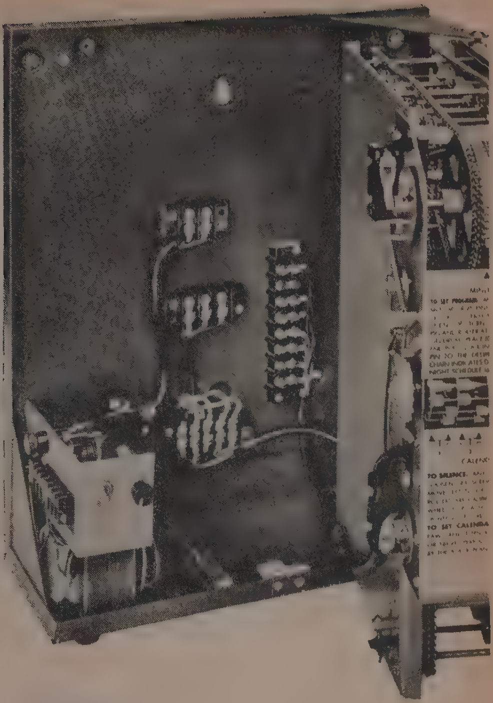
Q. *In Table 430-152, NEC we find the maximum rating or setting of motor branch-circuit protective devices.*

For instance, an ac 3-phase motor having a code letter "J," would normally be protected by fuses based on 300% of the motors full-load current rating.

In the case of a 3-phase motor having resistor starting, and also having a code letter "J," we again find that it would normally be protected by fuses based on 300% of the motor's full-load current rating.

If the purpose of resistor starting is to reduce starting inrush current, why is the fuse rating still based on 300% of the motor's full-load current rating? It would seem that this amount could be reduced to 200% or 250% or any other figure less than 300% depending on the current-limiting effect of the resistor-type starter. This is the case for motors with autotransformer starters.—R.C.M.

A. There is a distinction between the electrical characteristics of an autotransformer, and a resistance type of motor starter. This distinction has been recognized by the code, through Table 430-153, as far back as the 1933 edition of the code. The function of both types of starters is to reduce the inrush



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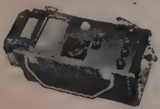

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current by lowering the voltage to the stator winding of the motor. It is contended that the resistance starter takes more current from the line than the autotransformer. An authority on the subject comments as follows:

"Undoubtedly more current is taken although the difference is not great, particularly in the case of a heavily loaded motor where perhaps 90% of full voltage is required in any case."

Many years ago some utilities objected to the use of resistance starters for the above reason.—B.A.McD. —11/60/5

Multi-Conductor Cables

Q. *Under NEC Section 336-1, a non-metallic sheathed cable is defined as an assembly of two or more insulated conductors having an outer sheath of moisture-resistant, flame-retardant, non-metallic material.*

Under NEC Section 336-2 "Construction," it reads "Non-metallic sheathed cable shall be an approved type NM or NMC in sizes No. 14 to 4 AWG inclusive."

The writer also found UL would only issue the "NM" or "NMC" label to cables of sizes No. 14 to No. 4 AWG.

Are cables of the multi-conductor type of size No. 3 AWG and larger, without a NM or NMC label but otherwise meeting NEC Section 336-1 requirement, considered as non-metallic sheathed cable?

In other words, if low-voltage (600 volts or less) multi-conductor cables rubber-insulated with neoprene jacket or polyvinyl chloride (PVC) jacket of sizes No. 3 AWG or larger are used as feeders running in cable tray in a manner meeting "NM" or "NMC" installation requirement, would the installation meet National Electrical Code requirement?—F.C.O.

A. Insofar as Article 336 of the code is concerned a cable assembly consisting of conductors No. 3 AWG and larger is not considered to come within the scope of this Article, regardless of the definition (Section 336-1). While the term "non-metallic" may apply, due to the nature of construction, the No. 4 limitation and other factors distinguishes one type from the other. Non-metallic sheathed cable describes and covers a wiring method recognized by Article 336 of the code, and the term should not be associated with other types of non-metallic cable assemblies. This opinion appears to be verified by the fact that UL only lists non-metallic sheathed cable in sizes No. 14 to 4 AWG, inclusive.

Article 339 of the code covers a non-metallic cable assembly designated "Uunderground Feeder and Branch Circuit Cable, Type UF." This type of cable is recognized in sizes No. 14 to No. 4/0 AWG, inclusive. It is also recognized for interior wiring in wet, dry, or corrosive locations. (See Section 339-3(d).)

Article 338 of the code covers service entrance cable. Types SE and US-E are non-metallic cable assemblies. There is no code limitation with respect to size, and such cable assemblies may be used for general interior wiring when all of the conductors are fully insulated. For details see Article 338.

The 600-volt multi-conductor cable, No. 3 or larger, as described in your question could be used as a feeder running in a cable tray provided it is listed by UL under any one of the types recognized by the code as above covered.—B.A.McD. 11/60/6

Neutral and Grounding Conductors

Q. *An installation consists of primarily a 3-phase motor load plus 5 kw of lighting requiring phase wires of 450 MCM. The maximum load the neutral will carry would be 2500/115 or 20 amps, and therefore, No. 8 should be adequate.*

However, Table 250-94(a) requires a No. 1/0 grounding conductor.

Is it proper to use a No. 8 neutral for the service entrance when a No. 1/0 grounding conductor is required?—F.C.

A. This question has been discussed quite a bit at various inspectors' meetings. To the best of my knowledge no definite answer has been given to this problem.

Many argue that the neutral may be of smaller size (as in this case No. 8) with the No. 1/0 grounding conductor tied to it. It is pointed out that in many installations—probably a very high percentage of all installations—a larger service entrance is provided by the user than the utility company's service drop. Often the service-drop neutral conductor is smaller than the required service grounding-conductor size.

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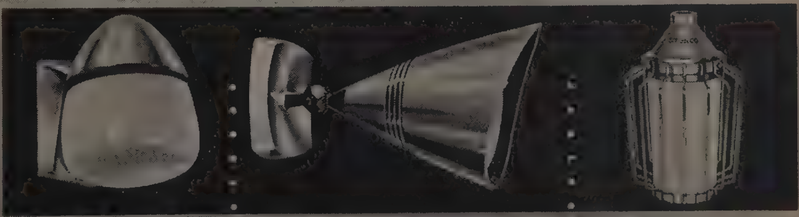

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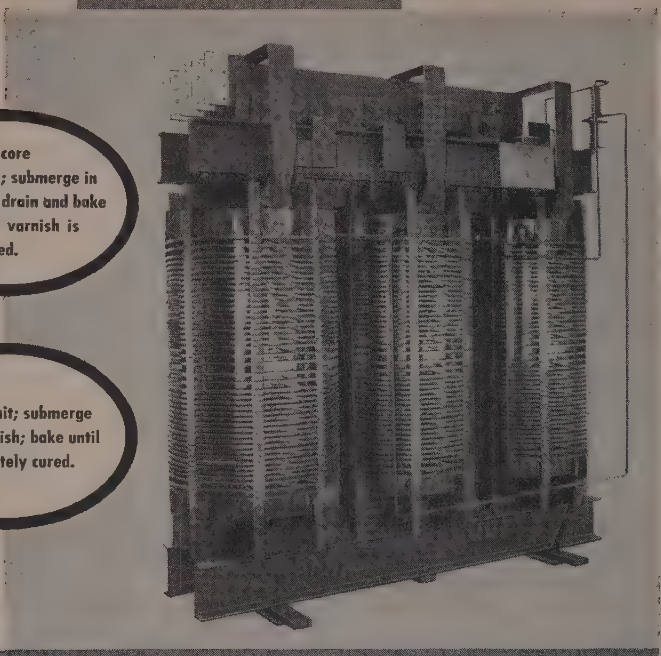

1 Preheat core and coils; submerge in varnish; drain and bake until the varnish is fully cured.

2 Cool unit; submerge in varnish; bake until completely cured.

Two impregnations with polymerizing varnish, baked twice for utmost protection

What makes a good transformer? For one thing—polymerizing *varnish* applied the Hevi-Duty way. It's another reason why Hevi-Duty transformers—single and three-phase up to 3000 KVA—have long service life and provide extra protection during periodic overload conditions.

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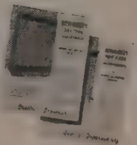

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On the other hand, we have the argument that if we require the larger current-carrying capacity in the grounding conductor, then we should provide for the same current-carrying capacity throughout the grounding path. Therefore, the neutral size would always equal at least that of the minimum grounding-conductor size.

As I noted above, this problem has come to the attention of the Code-Making Panel No. 5, and I am sure that it will come up with a definite resolution of this problem.

As for my personal feelings in the case, whenever I have to design such a system I always require the neutral to be sized at least as large as the service grounding conductor to be tied on to it. The utility-company neutral, if smaller, either in a service drop or service lateral can dissipate the excessive heat or even burn off from excessive current flow, in most cases without causing any damage to adjacent property. The service drop is completely isolated from the property, and the service lateral is usually well-protected underground.

There is the possibility of the service drop falling and contacting persons. Such fallen wires are usually well-exposed and visible and can be avoided by persons. Furthermore, a neutral break is not a serious personal hazard.—B.Z.S.—11/60/7

Adjacent Areas—Aircraft Hangars

Q. *Referring to paragraph 513-2(d) of the NEC, what constitutes "effectively cut off"? I note that the wording has been changed from that used in the 1956 Code in that the phrase "partitions" which are essentially "vapor tight" has been deleted.*

Let us assume a lean-to attached to an aircraft hangar and separated by a masonry partition containing a communicating door. A local interpretation stated that the lean-to area could be considered a nonhazardous area provided the door had a 1½-hr. fire rating. I do not agree with this interpretation as I cannot see how the nature of the door has anything to do with the area being "effectively cut off." I believe that the lean-to area must be considered as a hazardous area if any type of door or opening occurs in the partition between the areas. Your comments will be appreciated.—R.J.R.

A. The occasion for the revision of Section 513-2(d) of the code is recorded in the published Proposed Amendments of the 1956 edition of the NEC as follows:

"As written, the rule is subject to various interpretations, and is difficult to enforce."

As a result, Section 513-2(d) of the 1959 NEC was written to read:

"Adjacent areas in which hazardous vapors are not likely to be released such as stock rooms, electrical control rooms, and other similar locations, should not be classed as hazardous when adequately ventilated and effectively cut off from the hangar itself by walls or partitions."

The fact that you have questioned the significance of the phrase *"effectively cut off"* is an indication that the intent of the revision has not been satisfied. This is further verified by the fact that I also am unable to interpret this new phase with a background of authority. I am inclined to believe, however, that when the lean-to is adequately ventilated, and it is provided with a close-fitted door and a self-closing device, that the intent of the phrase *"effectively cut off"* is satisfied. The fact that the rule requires ventilation is an indication that some flammable gases may enter the lean-to. If the code intended to deny the use of door openings in a wall or partition, I believe the phrase in question should read "and when effectively cut off from the hangar itself by (unpierced) walls or partitions."

The occasion for a fire door with a 1½-hr fire rating may be influenced by insurance requirements. If the nature of the construction and the contents of the lean-to present an exposure to the hangar, it becomes apparent that the hangar and its valuable contents should be protected from such an exposure by an adequate fire door.

What constitutes a cut-off? What constitutes adequate ventilation? How does one determine the requirements for an effective cut-off? Such are the questions which arises when code rules are general in nature, and not specific. As covered by Section 90-7 the authority enforcing the code has the responsibility for interpreting such types of rules.

If the hangar is required to be cutoff completely by unpierced walls or partitions, access to other areas such as stock rooms, offices, toilets, etc. would be difficult. In fact one would have to leave the hangar and enter such areas through outside doors.—B.A.McD.—11/60/8

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59-2

Inspectors Meet in Regional Conferences

Code interpretation and trends are discussed at section meetings of the IAEI.

Highlights of the International Association of Electrical Inspectors meeting in Portland, Ore., Reno, Nev., Portsmouth, N. H., and Kansas City, Mo., as reported by *Electrical Construction* and *Maintenance* editors, disclose widespread interest in keeping the NEC rules and interpretations in time with current technical problems and product developments.

NW and SW Sections

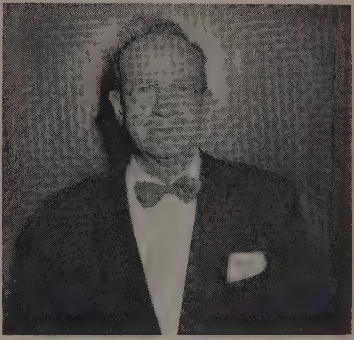
North and Southwestern Sections of the IAEI chalked up new attendance records when combined registrations at Portland, Ore., and Reno, Nev., totaled approximately 600.

E. F. Cogan, in a general report on Association business activities, reported that the membership had reached a total of 84,000 and that the organization was now standing on a healthy financial footing.

In a report pertaining to disconnecting means for 3-phase motors contained in mobile homes and trailers, Watson stated that the 1962 National Electrical Code will contain stricter wiring standards for motor courts, and that trailer service-entrance requirements will also be included. Appliance loads in trailers, used as permanent homes, are placing excessive loads upon branch circuits and feeders alike, he said. And considerable thought is presently being given by NFPA Committee men to insistence upon standardized receptacles for 115-volt, 30-amp and 230-volt, 50-amp use. In cases where electric heat is involved, a 110-amp service would be a minimum, he continued, with two 50-amp, 4-wire supply sources feeding two separate non-paralleled units, and with interconnected grounding provisions also provided.

A highlight of the Portland meeting was a discussion by S. J. Rosch, former consulting engineer for Anaconda Wire and Cable, who related ambient temperatures to conductors in raceways. He stressed the importance of multiplication factors in code tables, declaring that definite hazards could materialize by neglecting factors relating to such characteristics as voltage drop.

In addition to the above mentioned joint-session speakers, the Reno meeting was addressed by H. G. Ufer, who presented an inspiring message reminding inspectors of their public responsibility, while K. W. Swain, chief engineer of Chase-Shawmut, discussed interrupting capacities required on some modern systems and various types of fuses which could accommodate such interruptive values. Dr. William A. Nielander, Arizona State University, analyzed the public-relations phase of the inspector's job.


INCOMING PRESIDENT, of the eastern section IAEI, J. D. O'Connell, New York City, was elected at the 36th annual section meeting, held in Portsmouth, N. H.

ELECTRICAL INSPECTORS elected to official family of Western Section, International Association of Electrical Inspectors at recent Kansas City convention includes: (L to R) secretary-treasurer—D. M. Lines, Topeka, Kansas; 2nd vice president—E E. Patterson, Oklahoma City, Okla.; 1st vice president—H. B. Love, Detroit, Mich.; president—W. P. Hogan, Jr., Chicago, Ill. With the group after final session are International President P. J. Hicks, Jr., Providence, R. I., and retiring Western Section President W. E. Stewart of St. Louis, Mo.

In a series of three workshop sessions pertaining to proposed code changes in residential, commercial and industrial applications, a recurrent topic was the growing use of non-metallic piping systems for water, thus defeating the traditional means for grounding electric components. It was generally agreed that piping systems and metal structural framing should be bonded, and that existing water pipes should be supplemented by driven ground rods as well. The inspectors further suggested that clearer code definitions be related to the use of plastic conduit and cable trays.

In selecting officers for the coming year, the Northwestern section elected Edward M. Tubbs, president; Eldon Shirley, Billings, Mont., first vice president; Loren Christensen, Salt Lake City, second vice president; and W. L. Gaffney, Tacoma, secretary-treasurer.

Officers elected by the Southwestern section include Arthur P. Vesco, San Diego chief inspector, presi-

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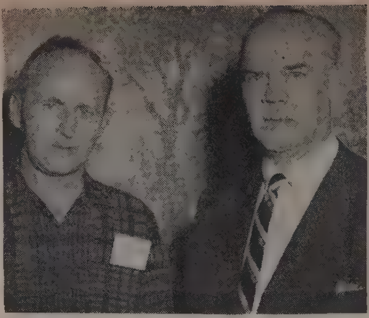

PRIVATE AND PUBLIC inspection departments from New York City were well represented at the recent IAEI Eastern Section meeting at Portsmouth, N H., including M. E. Newman (left), chief Borough inspector for the NYBFU; and J. W. Hager (right), Borough chief inspector for the Department of Water Supply, Gas and Electricity.

dent; Charles R. Pierce, Fresno chief inspector, first vice president; Paul Davison, Mesa, Ariz., second vice president; Walter Reed, Orange County Building inspector, third vice president; and L. E. Lafehr, Alhambra, secretary-treasurer. Representatives on the executive council will be E. E. Carlton, candidate for the first vice president, IAEI, and A. C. Veit, Los Angeles County. Alternates are Barney Alverson and C. H. Hefner, with the secretary as an ex-officio member. All members of the executive committee were returned to office with the exception of Lester Woldit, who is retiring from active service. In his place, Glenn S. Spears of Stockton was named.

These meetings at Portland and Reno were presided over by E. M. Tubbs, chief inspector of Bellingham, and by Ernest Nelson, inspector of San Leandro.

Dates for next-year's meetings were tentatively set for September 11-13 in Boise, and September 17-20 in Coronado.

Eastern Section

The Eastern Section of the International Association of Electrical Inspectors held its 36th annual meeting in the Wentworth By-the-Sea Hotel, Portsmouth, N. H., September 25 through 28. An interesting 3-day program included talks by industry authorities and the always-informative code-discussion periods. Another highlight at this convention was a "Discourse on Adequate Wiring," presented by seven speakers, each an expert in his respective field. Also, leading manufacturers exhibited a wide variety of new electrical products.

At the meeting, J. D. O'Connell, control director for the Consolidated Edison Company, New York City, was elected president of the Eastern Section for 1961, succeeding G. J. Bostley, Albany, N. Y. Other officers elected include: J. W. Mannix, Belmont, Mass., first vice president; C. L. Kelly, Sr., Bridgeport, Conn., second vice president; R. L. Lloyd, Washington, D. C., third vice president; V. E. Klein, Syracuse, N. Y., fourth vice president; and R. A. Jutstrom, South Weymouth, Mass., secretary-treasurer.

Improved Licensing and Inspection—R. W. Osborn, Vice President, District 7, NECA, St. Louis, Mo., gave a talk on a sound approach to licensing electrical contractors and improving inspection standards. Mr. Osborn recommended county-wide licensing for electrical contractors in lieu of state or municipal licensing. And as an aid to electrical inspectors, he thought that changing their classification from "inspector" to "examiner" would simplify the task of promoting better pay for this group.

Discourse on Adequate Wiring—John F. Roberts of the Edison Electric Institute gave a talk on "Housepower," which he stated was a billion-dollar market. He pointed out that the "Live Better Electrically" national program will have ads in four outstanding magazines: *Life, Better Homes and Gardens, Saturday Evening Post,* and *Reader's Digest.* These four magazines have a circulation of 29,800,000. In addition, Mr. Roberts stated that electric heating ads will run in several leading trade publications aimed at the building trade.

DISCUSSING THE CODE at the recent Eastern Section IAEI meeting at Portsmouth, N. H., was a favorite topic among delegates. Comparing notes after a code session are: W. R. Wehle (left), Wehle Electric Co.; and L. P. Nordholm (right), electrical inspector, New York Board of Fire Underwriters, both from Binghamton, N. Y.

James O. Covington of the Consolidated Edison Company, New York City, presented "Adequate Wiring in a Complex Market" as his theme. In his talk, he revealed the tremendous success his company has had with their Adequate Wiring Program since its inception in 1953. Since that date with reflected figures through 1960, 5,768 apartment buildings, containing 203,901 apartment dwelling units, will have been rewired under their program. Mr. Covington attributed much of their success to the cooperation of the electrical contractors and inspectors plus an outstanding advertisement program with about 400 of Con-Ed's business representatives in their sales department promoting and selling wiring in assigned territories. The program in the past seven years has far exceeded their expectations with no leveling off indicated in the foreseeable future.

"The Engineer Looks at Adequate Wiring" was a talk presented by A. J. Kleinberger, consulting engineer, New York City. Mr. Kleinberger stressed that the term "Adequate Wiring" should be applied to new construction as well as to upgrading wiring in existing buildings, and that much of this responsibility rests on the shoulders of the electrical engineer.

Albert I. Pozner of the Pozner Electric Co., New York City, presented "The Contractor's Part in Adequate Wiring" as his talk and stated: "Contractors owe a great debt of gratitude to the utility company, the inspection departments, electrical associations, consultants, and lending institutions, who have through their collective efforts and guidance, enabled this program to grow and contractors with it."

CODE MODERATOR Carl Dane, Winchester, Mass., points to a NEC rule in answer to a question following the final code session at the Eastern Section IAEI meeting, held recently at Portsmouth, N. H.

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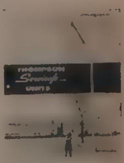

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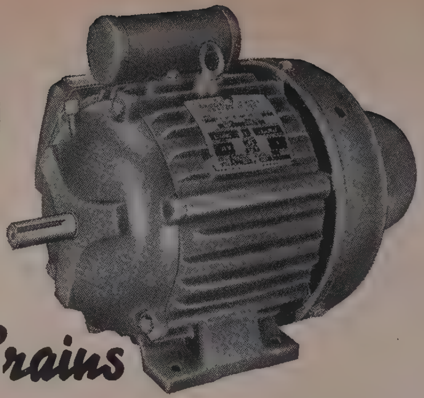

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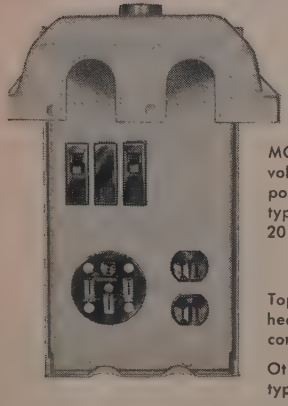

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CHAIRMAN H. H. WATSON (G. E. Co.) of the NFPA Subcommittee on Trailers and Trailer Coaches gives electrical inspectors meeting in Kansas City a rundown on proposed electrical standards which the committee hopes will be included in the 1962 National Electrical Code.

During the code discussion period, it was brought out that the NEC should provide an appropriate code article to cover the installation of cable-trough wiring systems. The Eastern Section went on record requesting that the NEC committee study this problem and provide the necessary code provisions to insure that proper installation will be made.

Over 300 registrants participated in the formal and forum sessions.

Western Section

The Western Section, International Association of Electrical Inspectors, held its 56th Annual Meeting in the Continental Hotel, Kansas City, Mo., Oct. 3-5. Approximately 480 registrants and guests attended the 3-day educational conference open to members from 19 states.

A need for uniform understanding and interpretation of electrical safety standards and the imperativeness of full industry cooperation permeated the sessions. With the constant advance in electrical applications, this need is greater today than ever before, noted Western Section President W. E. Stewart (St. Louis) in his opening address. Electrical inspectors hold a position of public trust. Proper discharge of duties requires the status of electrical inspectors to be raised above the levels of political intrigue, selfish personal interest, mistrust and doubt, Stewart added.

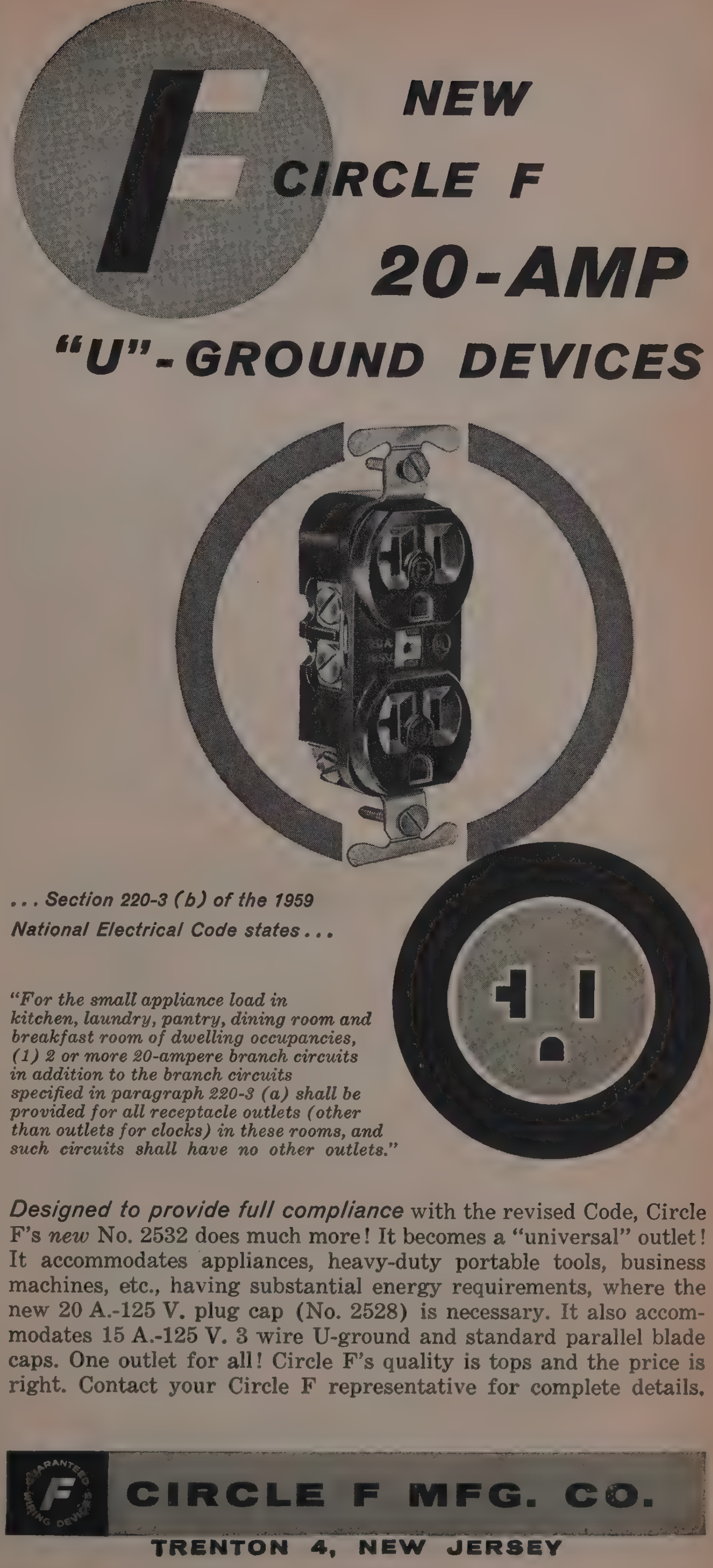
IAEI is making considerable progress and gaining stature as an

NFPA ENGINEER Frank Stetka, Chicago, secretary of the National Electrical Code Committee, chairman, Code Panel Session at Western Section, IAEI convention in Kansas City, warns inspectors of Dec. 1, 1960 deadline for proposed changes to present code.

organization, reported International President Peter J. Hicks, Jr. (Providence, R. I.). Among the specifics he related: a greatly improved financial condition; increased requests for IAEI representatives on industry committees; greater participation in AIEE and other technical association activities; more educational programs for electrical inspectors; a basic framework for increase in inspector status; development of good codes. Good building codes are only a legislative guide, he warned. To be effective, they need proper administration by qualified inspectors. A trade license and experience no longer constitute the prime qualification for an electrical inspector, he added. Basic training programs in human relations and technical advances must be established. Logically, improvement in inspector status and compensation commensurate with ability and responsibility will follow, Hicks predicted.

On the subject of inspector training, Tom McGinnis, state supervisor, Bureau of Apprenticeship and Training, U. S. Dept. of Labor, Topeka, Kansas, agreed that public relations and public information training was the electrical inspectors greatest need. He urged full use of local communications media—newspapers, radio, TV—to tell the electrical safety story; revealed that electrical inspector training classes can be set up by the Dept. of Labor Apprenticeship and Training Division.

That cities can successfully enforce their electrical codes was reported by Joseph P. Sestric, director of the Department of Public Safety, St. Louis, Mo. Of some 500 homes inspected for electrical safety, 80% required and got new



NEW CIRCLE F 20-AMP "U"-GROUND DEVICES

. . . Section 220-3 (b) of the 1959 National Electrical Code states . . .

"For the small appliance load in kitchen, laundry, pantry, dining room and breakfast room of dwelling occupancies, (1) 2 or more 20-ampere branch circuits in addition to the branch circuits specified in paragraph 220-3 (a) shall be provided for all receptacle outlets (other than outlets for clocks) in these rooms, and such circuits shall have no other outlets."

Designed to provide full compliance with the revised Code, Circle F's *new* No. 2532 does much more! It becomes a "universal" outlet! It accommodates appliances, heavy-duty portable tools, business machines, etc., having substantial energy requirements, where the new 20 A.-125 V. plug cap (No. 2528) is necessary. It also accommodates 15 A.-125 V. 3 wire U-ground and standard parallel blade caps. One outlet for all! Circle F's quality is tops and the price is right. Contact your Circle F representative for complete details.

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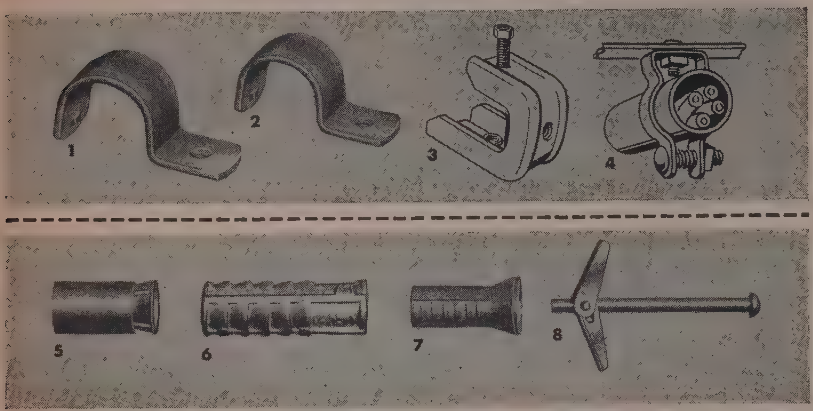

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2. Snap-Strap thinwall conduit — same style as the 700 line made to fit thinwall conduit.
3. Beam Clamps. Heavy gauge pressed steel-plated. Complete with case hardened set screw.
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Bulletin 160

THE Adalet MANUFACTURING COMPANY
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ATTENTIVE LISTENER Thomas Chrysler, chief electrical inspector, Lorain, Ohio, gets answers to searching questions from Chester Tressel, chief electrical inspector, Canton, Ohio, and member of the Western Section, IAEI executive committee. Both attended Western Section, IAEI convention in Kansas City.

services; 4,000 new receptacles were added and 3,000 others repaired, he noted. All this was accomplished without going to court. St. Louis has a court-upheld "right-of-entry" for city inspectors bent on uncovering code violations, Sestric revealed.

Technical Sessions

The need for thermal protection of fluorescent ballasts was explained by George E. Piper, product specialist, Metals and Controls Division, Texas Instrument Company, Attleboro, Mass. A ballast can be overheated enough to cause a violent (explosive) failure without drawing enough current to blow a fuse, he stated, advising that ballasts should be protected by a device that responds to temperature, current or a combination of both.

Inspectors were updated on the latest developments in aluminum cable, conduit and connectors by Roger Keith, Kaiser Aluminum & Chemical Sales, Inc., Newark, Ohio.

Sessions were devoted to a discussion of the NEC and inspector field problems. In the first session Code Panel Chairman Frank Stetka (Chicago, Ill.) had NEC Committee members O. K. Coleman (Lafayette, Ind.); Barron Whittaker (New York City); H. H. Watson (Bridgeport, Conn.); and L. S. Inskip (Murray Hill, N. J.) to help answer questions. The panel assisting Wm. P. Hogan (Chicago), moderator of the Field Problems Session, included: H. B. Love (Detroit); Howard Jaberg (Cincinnati); Charles Stasek (Cleveland); J. E. Fisher (Elkhart, Ind.); and Tom McGinnis (Topeka, Kansas).

Among the subjects discussed,

PROMINENT MEMBERS of Minnesota Electrical Association, Inc. (contractor group) at Western Section, IAEI convention in Kansas City included: (L to R) Wm. A. Ritt, past-president and permanent director; Harry Kane, manager; and Elroy Lehn who helped develop the association estimating manual.

and the panel concensus on same, were the following:

Higher Residential Voltages—Consideration is being given to higher utilization voltages in residences particularly with respect to electric heating.

Grounding—Double insulation on portable tools and appliances may not be too far off. This involves two distinct insulations any one of which could fail without causing a ground. There is some feeling that this insulation with a 2-wire cord may be safer than present 3-wire grounding cords.

Farm Loads—A 150-amp (minimum) to 200-amp service will take care of any future requirements for the average farm family. This will take up to 150 kw of connected load.

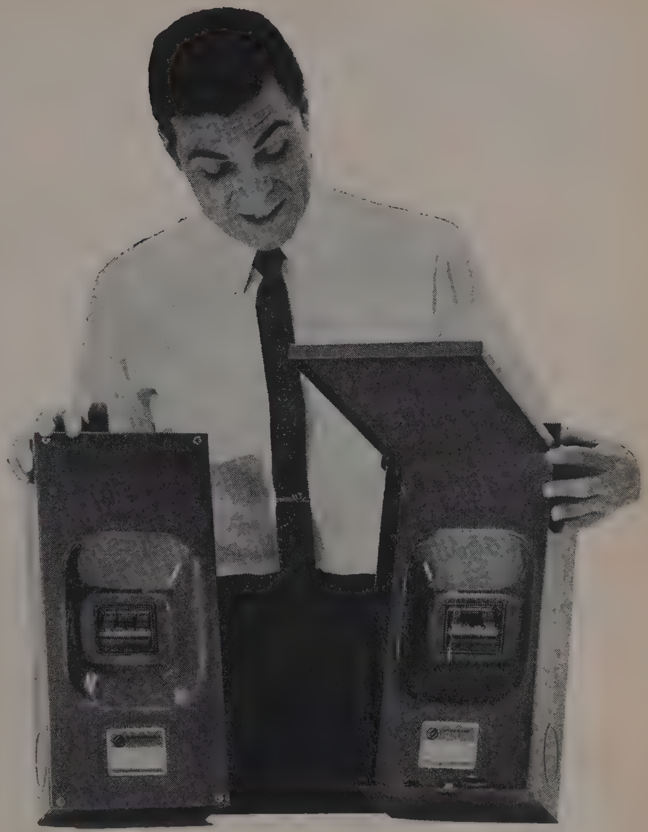
Swimming Pool Lighting—A proposal has been made to limit swimming pool lighting circuits to 15 volts through an isolating transformer. Problem of making high-wattage lamps for 15-volt operation is posed. NEC committee lacks data on potential gradient in water or effect of chemicals used to treat water; also has difficulty documenting swimming pool electrical accidents.

Design Levels—There is a move on foot to upgrade the 5 watts/sq ft for office buildings to a higher level. Present value considered too low.

Dual Breakers — Inspectors questioned an apparent trend to substitution of two breakers for one in panelboards; wondered if a UL approved 20-circuit panel might become a 40-circuit unit.

Motor Overload Protection—Should two or three overflow protective units be used on 3-phase motors? Henry Dreher, NEMA, New York, reported that during the

200-AMPERE CAPACITY



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Rated at 120/240V AC, two- or three-wire service, this unit is available with indoor or raintight, tamperproof outdoor enclosures. Either way, it costs less than what you are used to paying for fused equipment with 200-ampere capacity after de-rating.

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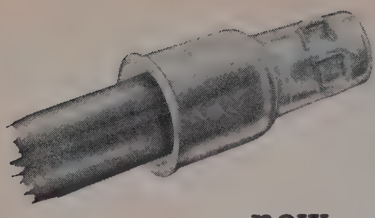

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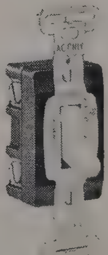

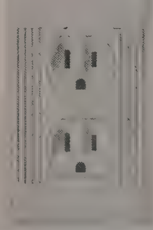

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WELCOME to the Western Section, IAEI past-president's group is given to Junior past-president W. E. Stewart, St. Louis, Mo., by senior past-president L. S. Crain, Lincoln, Neb , following election of new officers at Kansas City convention.

past year suitable questionnaires prepared by UL were mailed to 14,000 industry people. A 20% response resulted and the data is now being tabulated and analyzed by UL in Chicago to get an answer to this question.

New Officers

William P. Hogan, Jr., chief electrical inspector of Chicago, Ill., is the new president of the Western Section, IAEI. Other officers elected at this convention are: 1st vice president—H. B. Love, Detroit, Mich.; 2nd vice president—Eldon Patterson, Oklahoma City, Okla.; secretary-treasurer—D. M. Lines, Topeka, Kansas.

The 1961 convention of the Western Section will be held in Oklahoma City, Okla., September 25-27. The 1962 convention is scheduled for Chicago.

Graybar to Launch Nationwide Lighting Program

Graybar Electric Co. will launch a market expansion program directed at the relighting of commercial and industrial facilities. It is said to be the first such program ever to be undertaken by a wholesaler in the electrical industry.

The new market expansion program, called the Lighting Action Plan, has received the support and participation of more than 200 electrical utilities, 12 of the largest lighting fixture manufacturers, the world's largest lamp manufacturers, and the electrical contractors who will be the primary users

MUTUAL PROBLEMS of state electrical inspection work are aired at presession huddle during Western Section, IAEI convention in Kansas City, by Leo Nagel, chief inspector, North Dakota State Board of Electricity, Fargo, N. D.; and Niles Knutson, Minnesota State Board of Electricity, St. Cloud, Minn.

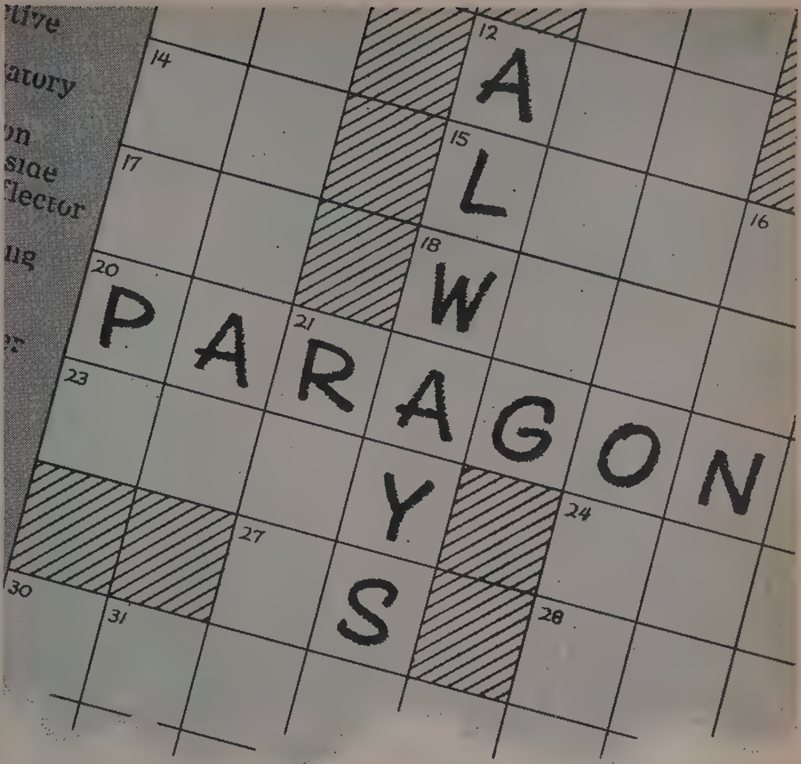
of the training and sales aids supplied by the program.

The relighting modernization market represents a potential $5 billion business, according to B. F. Benning, the Company's General Lamp and Lighting Sales Manager and one of a team of executives who introduced the LAP program at a press conference. "Add to this a related-product market (such as wiring) of approximately twice that amount, and you have one of the most dynamic profit markets in the electrical industry," he said.

Locally, for the electrical contractor, Benning estimated that the potential for fixture sales alone would amount to about $1 million in relighting for every population group of 25,000 people in the country.

The new marketing program, built around a line of specially-engineered lighting fixtures, is based upon the increasing need for improved levels of illumination in "older" commercial and industrial facilities. Generally, older construction refers to buildings erected prior to 1950. Construction since then has incorporated new techniques of lighting, which provide higher illumination levels. This, Benning pointed out, actually has spurred greater interest in the relighting modernization of older construction.

In addition, lighting research projects in the last few years have stressed the need for considering the human factor in the performance efficiency of any given visual tasks. Newly published standards of the Illuminating Engineering Society, for example, reflect the



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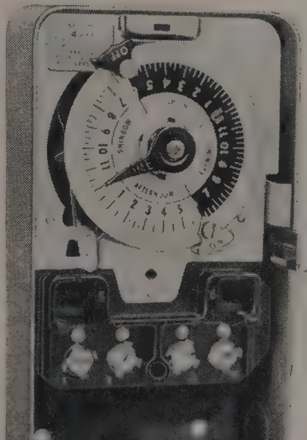

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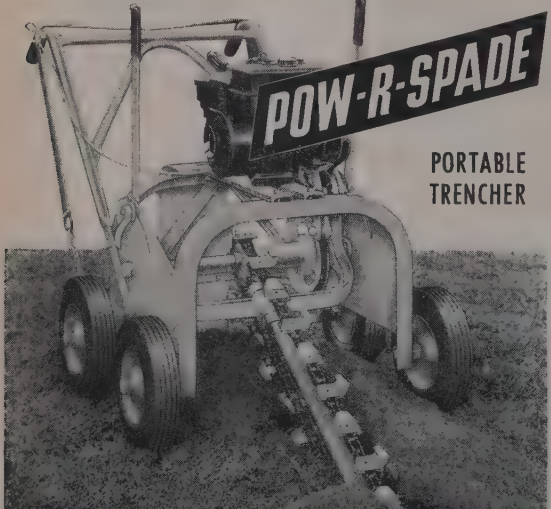

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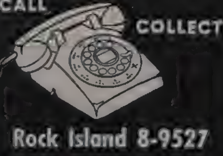


Rock Island 8-9527

need for approximately twice as much light as was recommended for most seeing tasks during the 1950's.

George H. Booth, Specialty Lamp and Lighting Sales Manager for Graybar, in introducing the sales and training aid part of the LAP program, said "this market demands creative selling on the part of manufacturers, utilities, and distributors, but especially by electrical contractors."

To sell this market, Booth warned that industry must "take the mystery" out of selling lighting so that fixtures can be merchandised to the commercial and industrial user as simply as consumer appliances are sold.

To meet these needs, Graybar, together with a selected group of manufacturers, developed a standardized line of lighting fixtures geared to the requirements of the relighting modernization market. This, Booth said, permits manufacturers to mass produce for high volume production savings which, in turn, provide the user with low cost fixtures in line with today's recommended lighting standards.

The Lighting Action Program will provide contractors with a complete package of training and selling aids concerning fixtures, lighting requirements, and the market. The package, for example, will contain a new light meter designed especially for use in the program. This new light meter has a rotary dial showing the recommended minimum lighting level for different areas within schools, offices, stores, industrial plants, etc. In using the meter, the dial is set for the space to be checked, and a color reading made to determine if the lighting is sufficient or below standard.

Also, in addition to sales aids and promotional literature, the program will supply a super-simplified lamp and lighting guide to give the contractor and user a quick understanding of the lighting needs in any given amount of space.

The LAP program will be introduced nationally by a sales force of more than 1000 Graybar personnel and the marketing manpower of participating manufacturers and utilities. Field meetings will be set up to bring suppliers together with contractors and utilities to tell them of the program. Sales training programs, manned by lighting specialists, will provide electrical contractors with information on how to design and sell actual lighting applications.

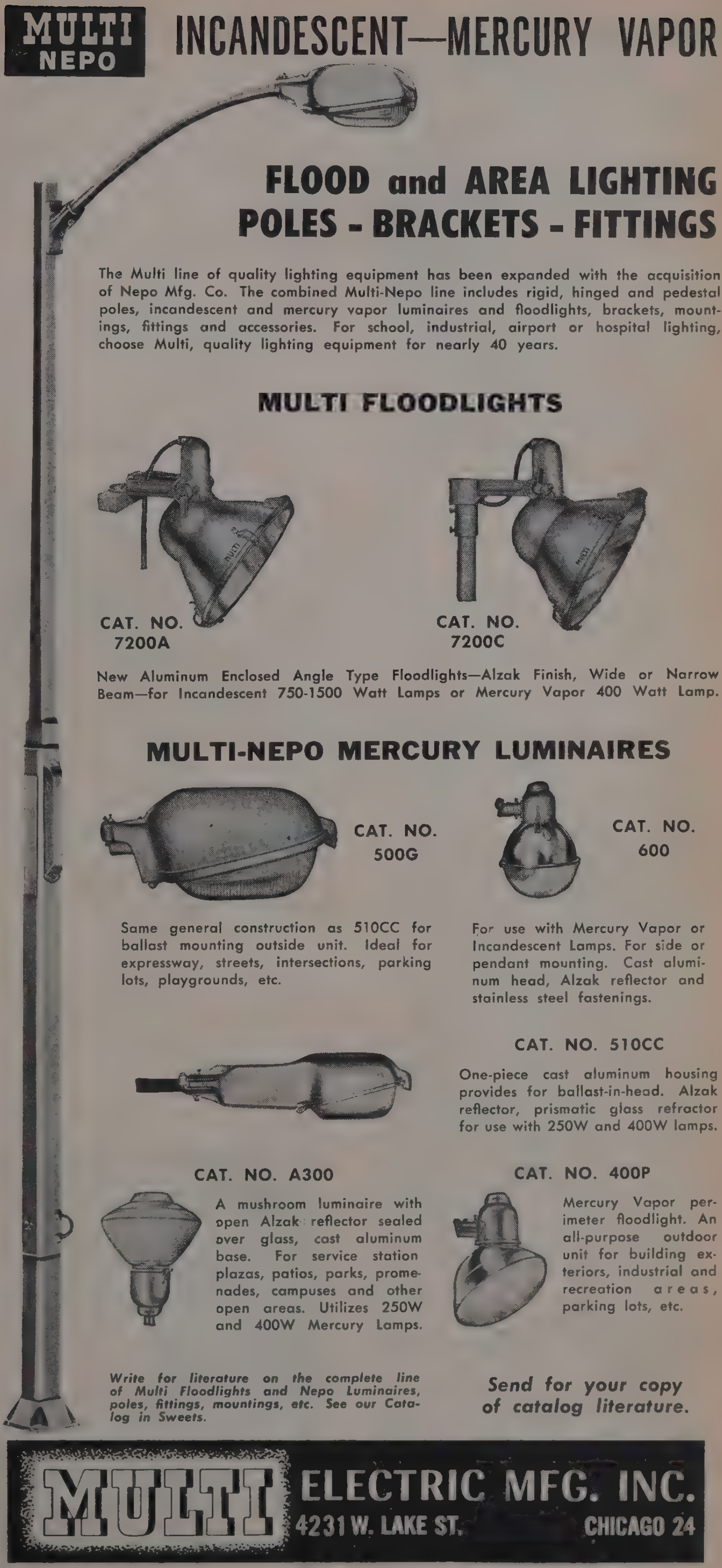
IES Annual Conference Held in Pittsburgh

The Illuminating Engineering Society held its 1960 National Technical Conference in Pittsburgh, Pa., September 11-16, and had a registration of approximately 900 members and guests—from all parts of the United States and Canada, and from five foreign countries: Bermuda, Japan, Mexico, the Netherlands, and Yugoslavia.

The Conference was opened by Charles L. Amick, chairman of the National Technical Conference Committee, and presiding officer for this session. He presented Joseph B. Browder, IES President, who reported on the Society's activities during the past year. Included in his report was a discussion of the Society's role in illuminating engineering research, through the IES-sponsored Illuminating Engineering Research Institute, and a plea for more funds to carry on this important work. President Browder also pointed out that IES is creating a profession, where one did not previously exist, and that it is unique in that it has published a handbook—the *IES Lighting Handbook*—based on its own researches and technical committee reports.

Other national officer reports were made by G. Franklin Dean, the IES General Secretary, and by Richard G. Slauer, IES President-elect (for 1960-61 fiscal year). Mr. Slauer commented on the basic research carried on by the Society, and asked "Has the Society accepted the challenge presented by the brilliant work of Dr. Blackwell?" He answered this question by saying "I don't believe it has," and proceeded to outline what industry should do to bring the benefits of Dr. Blackwell's work to mankind.

RICHARD G. SLAUER is the newly elected President of the Illuminating Engineering Society for 1960-61.



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A mushroom luminaire with open Alzak reflector sealed over glass, cast aluminum base. For service station plazas, patios, parks, promenades, campuses and other open areas. Utilizes 250W and 400W Mercury Lamps.

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1960 IES Fellows

President J. B. Browder announced that six members of the Society had been elected to Fellow grade by IES Council, and presented these individuals to the delegates in a pin-presentation ceremony. These new Fellows, and their outstanding technical contributions on which this signal recognition were based, are as follows:

G. B. Buck, district engineer, General Electric Co., Denver, Colo. —For contributions in the measurement and application of light.

Charles A. Douglas, assistant chief, Photometry and Colorimetry Section, National Bureau of Standards, Washington, D. C.—For applications of lighting to enhance aviation safety.

O. Phelps Meaker, senior specialist, Advanced Application Department, General Electric Co., Cleveland—For visual comfort research.

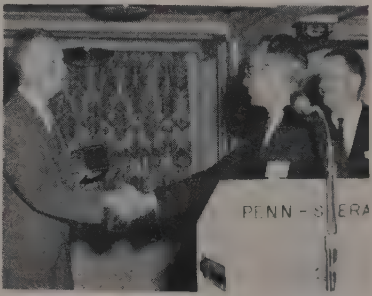
E. B. Noel, manager, Incandescent Lamp Design Engineering, General Electric Co., Cleveland—For significant developments in electric lamps.

Philip F. O'Brien, associate professor of Engineering, University of California, Los Angeles—For application of automatic computation to lighting problems.

Rollo Gillespie Williams, lighting consultant and director of Color Research, Century Lighting, Inc., New York City—For spectacular applications of lighting.

IES Gold Medal Award

Another highlight of the opening session was the presentation of the Society's Gold Medal to Willard C. Brown, "for universally meritorious achievement in the lighting field." Mr. Brown, well known throughout the lighting industry in the United States and abroad, retired earlier this year from his position as manager of Lighting Education, General Electric Co., Nela Park, Cleveland, after 40 years of activity in a variety of lighting fields. He is a Fellow of IES, and a former President of the Society.



WILLARD C. BROWN receives the Gold Medal of the Illuminating Engineering Society, which was awarded to him "for universally meritorious achievement in the lighting field," from IES President J. B. Browder, as J. F. Whitehead, chairman of the IES Gold Medal Award Committee, looks on.

Technical Papers

A total of 40 technical papers were presented. This required parallel sessions during most of the Conference. Space does not permit a detailed review of these papers, but the following were covered.

Five papers were devoted to lighting research. These included: Application of Sodium Lamps to Public Lighting; Measurement of Visual Information Cues; BCD Appraisals of Luminaire Brightness in a Simulated Office; Further Data on Discomfort Glare from Multiple Sources; Portable Reflectance Meter.

Two papers were devoted to residence lighting: Large Luminous Elements in Residential Design; Lighting Go-Round for the Sixties.

Four papers were presented on roadway lighting, three on ballasts, and four on photometry.

Eight papers were devoted to lighting applications. These were: Darkroom Lighting Systems; Progress in the Development and Application of Static Converters for High Frequency Fluorescent Lighting; Lighting of Airport Service Areas; Design and Performance of an Inset Runway Light; Performance of Air Handling Troffers; Maintenance Factors for Interior Lighting; Engineering Designs for Residential Lighting; and Light Transmitting Plastic Enclosures for Outdoor Lighting Equipment.

Fourteen papers were devoted to light sources. These included: Design of Fluorescent Lamps for Photoduplicating Service; Multilayer and Flexible Single Layer Electroluminescent Lamps; Ceramic Multilayer Multicolor Electroluminescent Lamp; A New Two-Level Lamp for Residence Application; Developments in Quartz Infrared Lamp; 40-Watt Fluorescent Lamp With Higher Output; Interflections in Aperture Lamps; Design and Characteristics of Aperture Fluorescent Lamps; Aperture Fluorescent Lamps—Applied; Computer Programming for Controlled Fluorescent Lighting; Color of High Pressure Mercury Lamps; The Effect of Operating Position and Circuit Variations on Mercury Lamp Characteristics; Design and Application of Outdoor Fluorescent Lamps; and Air Ions Using Ultraviolet Lamps.

An evening session was devoted to what has developed into a highlight of every annual IES Conference—the Lighting Progress Report. This was an illustrated report, and a demonstration of the newest in light sources, luminaires, lighting techniques and control. It was assembled by the Committee on Lighting Progress, from research and development laboratories across the nation, and presented by M. K. Strang, Curtis-Allbrite Lighting of Canada, Ltd., chairman.

Lighting Contest

The run-off of the Applied Lighting Competition, presented in two classes, was another event of great interest to the delegates. Class I covered Regional winners in residential lighting, and Class II covered Regional winners in commercial-industrial lighting. There were eleven entries in each class.

Class I—Residential Lighting winners were:

First Prize—Sylvan R. Shemitz, C. W. Mersick Electric Supply Corp., West Haven, Conn., for his entry on "A Living Laboratory for Light for Living."

Second Prize—Jack T. Cottingham, Portland General Electric Co., Portland, Ore., for his entry on "How to Live Happily—With Lighting."

Third Prize — Robert Haskell, Pacific Gas & Electric Co., San Francisco, for his entry on "New Lamps for Old."

Fourth Prize—Alfred Makulec, General Electric Co., Cleveland, for his entry on "High Footcandle Structural Lighting in a Residence."

Class II—Commercial-Industrial Lighting winners were:

First Prize—Louis N. Goodman, Goodman & Associates, New Orleans, for his entry on "Lighting Main Concourse, Moisant International Airport."

Second Prize—William McCarthy, Niagara Mohawk Power Corp., Buffalo, N. Y., for his entry on "Lighting the Amherst Lanes."

Third Prize—R. E. Buell, Northern Electric Co., Ltd., Halifax, N. S. (Canada), for his entry on "Shopping Center Restaurant."

Fourth Prize—D. Dana Price, Golomon & Rolfe, Houston, Texas, for his entry on "St. Theresa Church."

New Officers

The newly elected officers of the Society are: *President*—Richard G.

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These two cable trays have been thoroughly field tested in hundreds of large industrial installations, in new plant construction, in power plants, in modernization, and for power distribution in all types of manufacturing processes. A new catalog, just off the press, gives full information and installation techniques. Ask for your FREE copy today.

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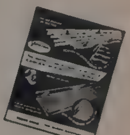

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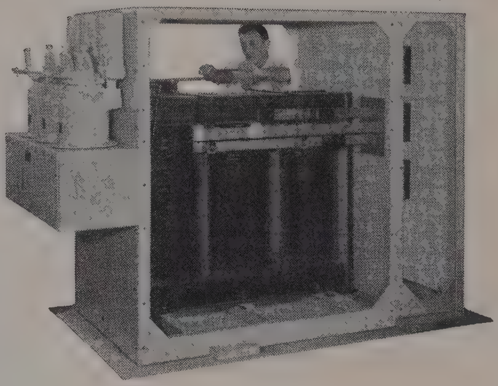

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All LAND-AIR DRI-TRAN products meet applicable NEMA and ASA specifications—for further information write or call—

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SPEAKER at the special luncheon for Sustaining Members of the Illuminating Engineering Society, held during the 1960 IES National Technical Conference in Pittsburgh, September 13, was M. I. Allen, vice president—sales, Philadelphia Electric Co., Philadelphia, Pa. In his talk on "Cracking the Light Barrier," he urged continued and stepped-up support of research in the field of light and vision, by the Illuminating Engineering Research Institute, as a major factor in continued growth of the lighting industry. At left is George J. Taylor, chairman of the IES Sustaining Membership Committee.

Slauer, manager of Engineering, Sylvania Electric Products Inc., Wheeling, W. Va.; *Vice President*—J. R. Chambers, sales manager, Lighting Products Division, Appleton Electric Mfg. Co., Chicago; *Vice President*—G. Franklin Dean, supervising engineer of Lighting Service, Toronto Hydro-Electric System, Toronto, Ont., Canada; *General Secretary*—J. Dixon Mitchell, regional engineer, Southeastern Region, Lamp Division, Westinghouse Electric Corp., Chamblee, Ga.; *Treasurer*—William P. Lowell, Jr., manager of Technical Liason and Quality Control Depts., Sylvania Lighting Products Inc., Salem, Mass.

Also elected to office were seven new regional vice presidents and two directors. Newly elected regional vice presidents are: *Great Lakes Region*—Alston Rodgers, General Electric Lighting Institute, Cleveland; *Midwest Region*—Richard D. Cohen, Glasco Electric Co., St. Louis; *South Central Region*—John Sharp Williams, IV, Arkansas Power & Light Co., Little Rock, Ark.; *South Pacific Coast Region*—Roy H. Kreyser, Dept. of Water & Power, City of Los Angeles; *Pacific Northwest Region*—Jack T. Cottingham, Portland General Electric Co., Portland, Ore.; *North Central Region*—Richard M. Smart, Sylvania Electric Products Inc., Melrose Park, Ill.; and *Northeastern Region*—Robert L. Zahour, Westinghouse Electric Corp., Bloomfield, N. J.

NISA News

Presidents and secretaries of the association's 40 chapters met in St. Louis, October 14-15, at Hotel Coronado for the 3rd Annual Conference of the National Industrial Service Association, Inc.

More than 50 attended the two-day session which included discussions of better chapter organization and relations with the national headquarters. Dick Bradley, Bradley's Electric Service, Corpus Christi, Texas, presided.

• • • •

Western Michigan and Great Lakes Chapter held a joint meeting at the Hoover Ball and Bearing Co. plant in Ann Arbor on October 17.

• • • •

California's three NISA chapters, Northern California, Los Angeles and San Diego, met in San Francisco on October 1, for an all-day program which included talks by L. E. Long, Wagner Electric Corp.; Don Freas, Thomas & Betts Co.; Marc Aynes, Louis Allis Co.; Ronald Clark, Phelps Dodge Copper Products; and J. D. Mays, John C. Dolph Co.

• • • •

The new NISA staff engineer, August A. Baechle, was among the speakers at the Pacific Northwest Conference at Grosvenor Hotel, Vancouver, B. C., October 21-22. Also addressing the members of the British Columbia, Oregon and Puget Sound chapters were E. C. Creelman, W. L. Stevens, Ltd.; G. A. Wilkinson, Marwell Construction Co.; and R. White, Dow Corning Corp.

• • • •

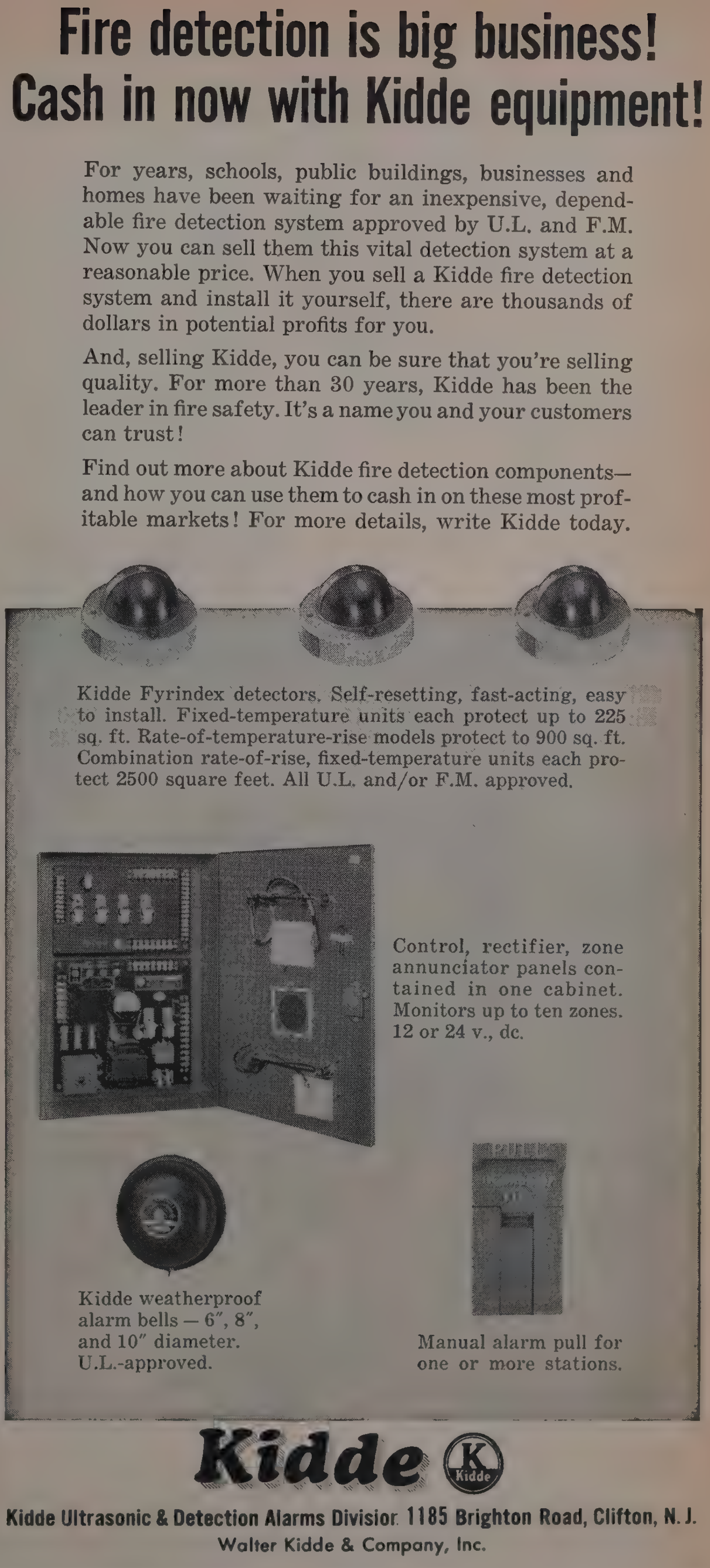
Shops were advised to improve their equipment and techniques and to train new men for the coming expansion of industry in the Chicago area by a utility executive, Loren C. Trimble, Commonwealth Edison Co.'s director of industrial development. He spoke at a meeting of the Chicago Chapter on September 13 at Petricca's Restaurant.

• • • •

William Pickett, president; Thomas Gower, vice-president; and Orville Waller, secretary-treasurer, were re-elected to two-year terms by the Heart of America Chapter of NISA at the group's meeting in Forsyth, Mo., October 14-15.

• • • •

Eaton Manufacturing Co.'s Ed Osinski and Vincent Turner were speakers at the Quaker City Chapter meeting October 12 in Philadelphia, discussing adjustable speed drives and controls.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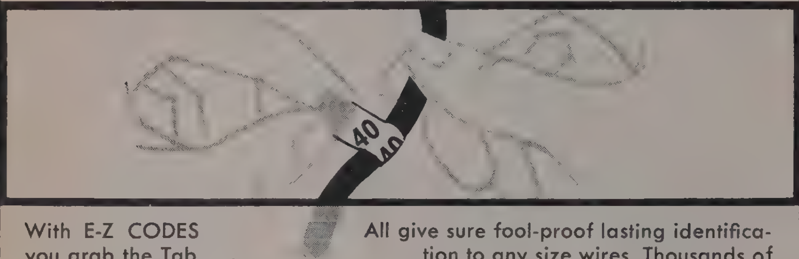

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DATES AHEAD

National Fire Protection Association—Fall Conference, Columbus, Ohio, November 14-16.

National Electrical Manufacturers Assn.—Annual meeting, Traymore Hotel, Atlantic City, N. J., November 14-18.

Electrical & Home Appliance Show—Electrical Building, Balboa Park, San Diego, Calif., November 25-30.

The Third National Conference on the Application of Electrical Insulation—Co-sponsored by the AIEE and NEMA, Conrad Hilton Hotel, Chicago, Ill., December 5-8.

Industrial Heating Equipment Association, Inc.—Dearborn Inn, Dearborn, Mich., January 23-24, 1961.

Plant Maintenance and Engineering Show—International Amphitheatre, Chicago, Ill., January 23-26.

Intermountain Electrical Association—Annual conference, Hotel Ben Lomond, Ogden, Utah, February 2.

Power & Communications Contractors Association—Annual convention, Sir Francis Drake Hotel, San Francisco, Calif., February 5-7.

National Electrical Week—National promotion, February 5-12.

National Rural Electric Cooperative Association—19th annual meeting, Dallas, Texas, February 13-16.

15th International Heating & Air-Conditioning Exposition—International Amphitheatre, Chicago, Ill., February 13-16.

3rd Biennial Electrical Trade Conference and Exposition—Sheraton-Park Hotel, Washington, D. C., February 14-16.

Upper Midwest Electrical Industry Convention — Leamington Hotel, Minneapolis, Minn., February 19-22.

National Electric Sign Association—Convention, Benjamin Franklin Hotel, Philadelphia, Pa., Feb. 19-22.

Electrical Show—1961 Denver Electrical and Electronics Exhibit, Denver Hilton Hotel, Denver, Colo., February 21-22.

17th Annual National Wiring Sales Conference—Sherman Hotel, Chicago, Ill., February 23-24.

3rd National Lighting Exposition and World Light Forum—Coliseum, New York City, N. Y., March 8-15.

Edison Electric Institute — Annual sales conference, Edgewater Beach Hotel, Chicago, Ill., March 20-22.

Institute of Radio Engineers, Inc.—International Convention and Show, Waldorf-Astoria Hotel and New York Coliseum, New York, N. Y., March 20-23.

American Power Conference—Sherman Hotel, Chicago, Ill., March 21-23.

Nebraska Iowa Electrical Council—4th Biennial Nebraska Iowa Electric Trade Show, Peony Park Auditorium, Omaha, Neb., March 21-23.

Electrical Supply Trade Show—Sponsored by the Electrical Association of Kansas City, Exhibition Hall, Municipal Auditorium, Kansas City, Mo., March 28-30.

Electrical Trade Show—Sponsored by St. Louis Electrical Board of Trade, April 4-6.

Northern California Electrical Industry Show—Sponsored by the Electrical Maintenance Engineers' Association of Northern California, Brooks Hall, San Francisco, Calif., April 5-9.

Missouri Valley Electrical Association—Annual engineering conference, Hotel President and Municipal Auditorium, Kansas City, Mo., April 12-14.

2nd Annual Alabama Electrical & Electronics Exposition—Birmingham Municipal Auditorium, Birmingham, Ala., April 17-19.

National Association of Electrical Distributors—53rd annual convention, Detroit, Mich., April 29-May 3.

National Fire Protection Association—Annual convention, Hotel Statler, Detroit, Mich., May 15-19.

Pacific Coast Electrical Association, Inc.—Annual convention, Sheraton-Palace Hotel, San Francisco, Calif., May 17-19.

Edison Electric Institute—Annual convention, New York, N. Y., June 5-7.

Electrical Apparatus Service Association, Inc.—28th annual convention, Jack Tar Hotel, San Francisco, Calif., June 11-14.

Western Plant Maintenance Show—Pan American Auditorium, Los Angeles, Calif., July 18-20.

Western Electronic Show and Convention—Cow Palace, San Francisco, Calif., August 22-25.

American Home Lighting Fixture Month—Sponsored by the American Home Lighting Institute, Chicago, Ill., September 1-30.

Canadian Electrical Manufacturing Association—Annual meeting, Sheraton Brock Hotel, Niagara Falls, Ontario, October 4-6.

National Electrical Contractors Association—Annual convention, Washington, D. C., October 9-14.

GEORGE HILTON, Underwriters' Laboratories, Inc., Boston, Mass., takes a break after a lively code panel discussion at the 36th annual IAEI Eastern Section meeting, held in Portsmouth, N. H.

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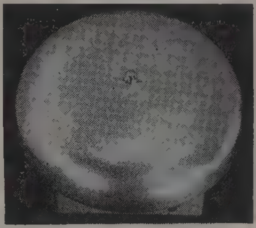
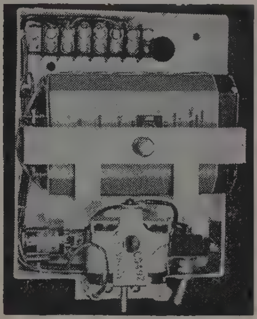


Photo showing 8 in. bell of LIFE SAVER SR. MODEL C1



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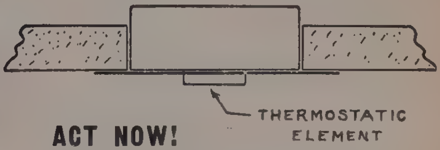

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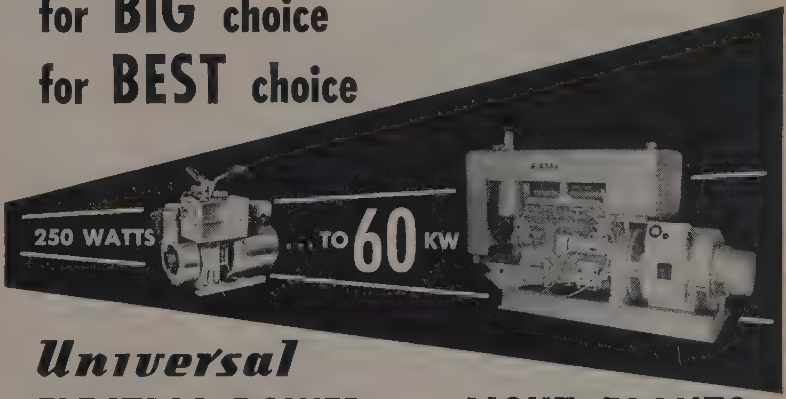

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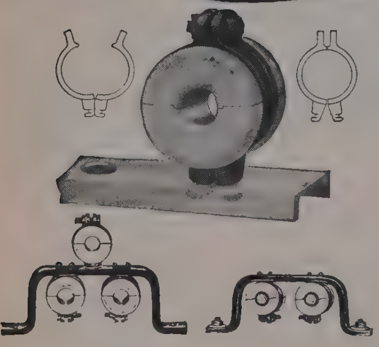

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Headquarters Announcements

Hitemp Wires, Inc., Westbury, L. I., is now a division of the **Simplex Wire and Cable Co.,** Cambridge, Mass., and will operate as The Hitemp Wires Co. George F. Rolfe continues as president and general manager.

The American Brass Co., Waterbury, Conn., a subsidiary of the Anaconda Co., has changed its name to **Anaconda American Brass Co.**

National Pneumatic Co., Inc., Boston, Mass., has acquired substantially all of the assets of **Janette Electric Mfg. Co.,** Chicago, to be known as Janette Mfg. Co.

Kuhlman Electric Co., Birmingham, Mich.—Arthur Kaufmann, assistant general manager, in addition to existing duties as vice president and treasurer.

Preformed Line Products Co., Cleveland, Ohio—Thomas E. Sherman, sales engineer, Power Industry Products.

Westinghouse Electric Corp., Pittsburgh, Pa.—Frank H. Muns, manager of business systems, Lamp Div., Bloomfield, N. J.

Wilbur B. Driver Co., Newark, N. J.—Ernest W. Swift, vice president of sales; Fred A. Locke, director of sales engineering.

Koppers Co., Inc., Pittsburgh, Pa.—Jack D. Rice, vice president.

White-Rodgers Co., St. Louis, Mo.—William L. Mayo, product manager; Edward E. Harwood, sales manager, Original Equipment Manufacturer Div.; John H. Martin, sales manager, Wholesaler Div.

Taylor Fibre Co., Norristown, Pa.—Harry L. Hildebrand, manager, Process and Design Engineering; John G. Musselman, manager, Fabricating Div.

General Electric Co., Schenectady, N. Y.—O. L. Shay, manager, switchgear sales, Medium Voltage Switchgear Dept., Philadelphia; Stanley A. Gorski, manager of marketing, Appliance Control Dept., Morrison, Ill.

Continental Electric Equipment Co., Cincinnati, Ohio—John M. Townsend, president and director; John B. Cottell, chairman of the board.

Royal Electric Mfg. Co., Chicago, Ill.—William H. Boyce, vice president, Industries Div.

Sperti Products, Inc., Cincinnati, Ohio—Ray L. Sperber, vice

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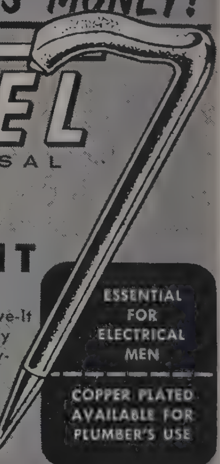

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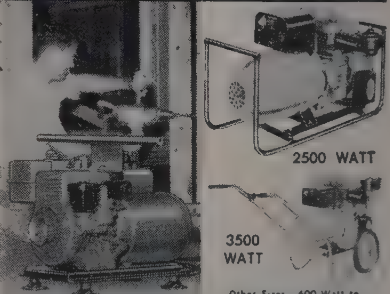

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Gould-National Batteries, Inc., St. Paul, Minn.—A. R. Penfield, director of advertising.

Circle Wire & Cable Corp., Maspeth, L. I., N. Y.—S. Manuel Pearl, sales vice president.

Delta-Star Electric Div., H. K. Porter Co., Inc., Chicago, Ill.—Stuart W. Johnson, product sales manager of transformers, Electric Service Works, Philadelphia; Walter E. Taylor, Jr., manager of engineering, and William F. Hiel, manager of manufacturing, Thomas Works, Lisbon, Ohio; George S. Arneson, director of marketing, Pittsburgh, Pa.

Sierra Electric Corp., Gardena, Calif.—Robert E. V. Ramsing, national sales manager.

Chester Cable Corp., Chester, N. Y.—Henry S. Loeber, sales manager; Benjamin Levinson, chief engineer.

Marquardt Corp., Van Nuys, Calif.—Stuart E. Weaver, vice president, marketing; Harry B. Horne, vice president, corporate planning.

General Electric Co., Plainville, Conn.—John A. Kelly, manager, customer service and marketing administration, Circuit Protective Devices Dept.

Black & Decker Mfg. Co., Towson, Md.—John L. Turnbaugh, plant manager.

Edwards Co., Inc., Norwalk, Conn.—Randall S. Stevens, advertising manager.

Square D Co., Park Ridge, Ill.—Ray W. Thompson, general sales manager, Marketing Div.

Triangle Conduit & Cable Co., Inc., New Brunswick, N. J.—J. G. Slater, vice chairman of the board of directors; C. S. Menger, president; C. V. McKay, executive vice president.

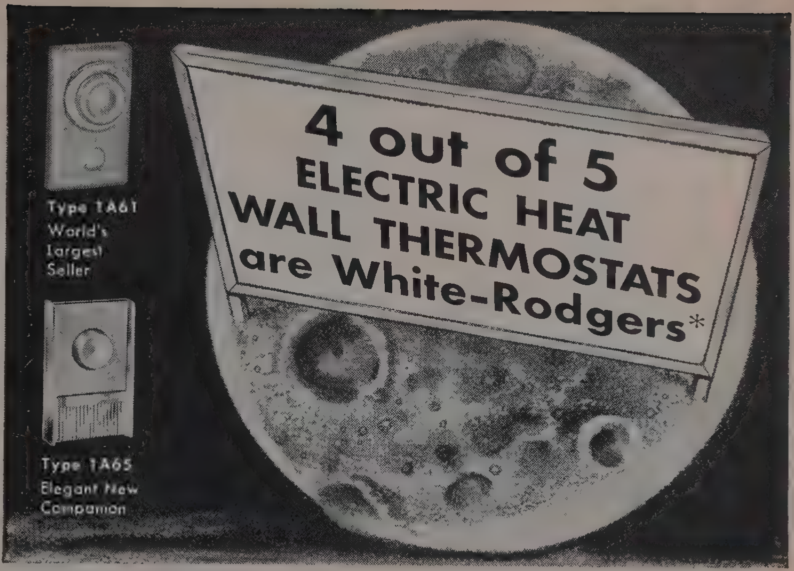
Minneapolis-Honeywell Regulator Co., Freeport, Ill.—John K. Lincoln, sales manager, Micro Switch Div.; Kenneth J. Cumming, sales manager, Marion Instrument Div., Manchester, N. H.

Cornell Cables, Inc., Cleveland, Ohio—Robert Miller, sales manager.

Bohn Aluminum & Brass Corp., Detroit, Mich.—Raymond J. Hodgson, board of directors.

J. I. Case Co., Racine, Wis.—A. Earl Lee, vice president, Marketing Div.

The Philip Carey Mfg. Co., Cincinnati, Ohio—W. W. Rowe, Jr.,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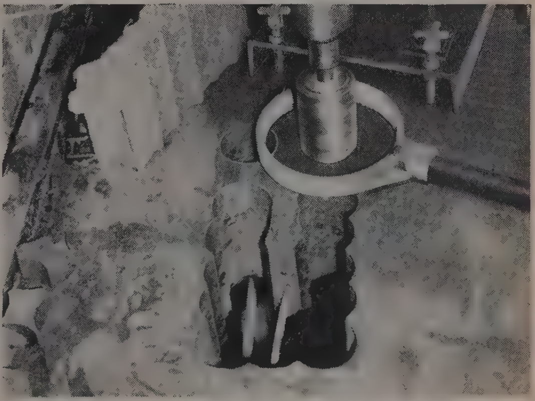

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NEW ENGLAND

Radio Corp. of America: New England Communications, Inc., Wellesley, Mass., representative.

The Kirlin Co.: Richard Donnelly Co., Suffield, Conn., sales representative for Connecticut and four western counties of Massachusetts.

MIDDLE ATLANTIC

Crouse-Hinds Co.: Richard F. Kidwell, regional manager, central New York region, headquarters in Albany; James E. Blake, regional manager, New York region; Robert I. Browning, manager, Pittsburgh region.

Multi-Amp Electronic Corp.: Burns Electric Co., Pittsburgh, Pa., representative for western Pennsylvania and northern West Virginia.

Joy Manufacturing Co.: Jack K. Adams, manufacturing manager, Franklin, Pa., plant.

SOUTH ATLANTIC

National Electric Div., H. K. Porter Co., Inc.: Irvin C. Turner, branch manager, Charlotte, N. C.

Crouse-Hinds Co.: Jay M. Witbeck, regional manager, Charlotte, N. C.

Progress Manufacturing Co.: LeRoy Stark, representative for southern Florida.

EAST CENTRAL

Joy Manufacturing Co.: C. A. Patten, works manager, New Philadelphia, Ohio plant.

Square D Co.: Kurt Morris, midwestern region manager, headquarters in Schiller Park, Illinois plant.

Progress Manufacturing Co.: Charles F. Sibley, representative for eastern Tennessee, Alabama and the Pensacola, Fla., area.

Owatonna Tool Co.: William M. Myers, district sales manager for Illinois with the exception of Chicago.

Olin Mathieson Chemical Corp.: James R. Whitlock, manager, sales office, located at Louisville, Kentucky.

Wolverine Tube: R. C. Cash, sales manager, Chicago district; John P. Howland, sales manager, Birmingham district.

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Of Electrical Construction and Maintenance, published monthly at Albany, New York for October 1, 1960.

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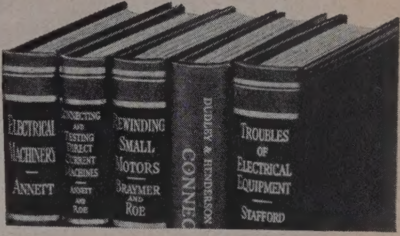
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Advertising In This Issue

Abolite Lighting Div., The Jones Metal Products Co. ... 36
Ackerman-Johnson Co. ... 203
Adalet Mfg. Co., The ... 216
Adam Electric Co., Frank ... 55
● Advance Transformer Co. ... 123
Alexander-Tagg Industries, Inc. ... 230
Allen-Bradley Co. ... 69, 70
Allis-Chalmers Mfg. Co. ... 37, 39
● All-Steel Equipment, Inc.—Raco Div. 187
● American Biltrite Rubber Co., Boston Woven Hose & Rubber Div. ... 33
● American Louver Co. ... 15
● American Steel & Wire Div. of U. S. Steel ... 76, 77
American Telephone & Telegraph Co. 14
Amprobe A Div. of Pyramid Instr. Corp. ... 19
● Anaconda Metal Hose ... 157
Appleton Electric Co. ... 2
● Arrolet Corp. ... 176
Arrow-Hart & Hegeman Electric Co.. 171
172, 174, 175
● Automatic Switch Co. ... 75

Baker-Roos, Inc. ... 158
Bell Telephone System ... 14
Bethlehem Steel Co. ... 54
● Biddle Co., James G. ... 206
Black & Decker Mfg. Co., The ... 136, 137
● Blackhawk Industries ... 216
● Briegel Method Tool Co. ... 6
● Brook Motor Corp. ... 214
● Buchanan Electrical Prod. Corp. ... 218
BullDog Electrical Products Division I-T-E Circuit Breaker Co. ... 165, 167
Burndy Corp. ... 193
Bussmann Mfg. Co. ... 12, 13

Century Electric Co. ... 210
Certified Ballast Manufacturers ... 31
Champion Lamp Works ... 209
Charles Machine Works, Inc. ... 224
Chase-Shawmut Co., The ... 188
Cincinnati Time Recorder Co. ... 205
● Circle F Mfg. Co. ... 215
Circle Wire & Cable a Subsidiary of Cerro de Pasco Corp. ... 30
Clark Controller Co., The ... 189
Columbia Cable & Electric Corp. ... 47
Cornell Cables Inc. ... 230
Cornish Wire Co., Inc. ... 149
● Crescent Insulated Wire & Cable Co., Inc. ... 51
● Crouse-Hinds Co. ... Fourth Cover, 127
128, 129, 130, 131

● Cutler-Hammer, Inc. ... 34, 35
● Day-Brite Lighting, Inc. ... 184, 185
Dodge Corp., F. W. ... 68
Dow Corning Corp. ... 11
duPont De Nemours & Co., Inc. ... 74

● Efficiency Electric & Mfg. Co. ... 228
Electrical Construction & Maintenance 226
Enjay Chemical Company, A Division of Humble Oil & Refining Co. ... 179

Federal Pacific Electric Co. ... 40, 41
Fire Alarm Thermostat Corp. ... 227
● Fullman Mfg. Co. ... 156

Garcy Lighting Div. of Garden City Plating & Mfg. Co. ... 201
Gedney Electric Co. ... 195
● General Electric Co.
  Apparatus Sales Div. ... 8, 18, 20, 21
  80, 147
  ● Circuit Protective Devices Dept. ... 43
  Lamp Div. ... 58
  Silicone Products Dept. ... 191
  Wiring Device Dept. ... 66
Gibson Mfg. Co. ... 141
Globe Co., The ... 223
● Graybar Electric Co., Inc. ... 4
Greenlee Tool Co. ... 44, 45
Guth Co., Edwin F., The ... Second Cover

Heinemann Electric Co. ... 217
● Helwig Carbon Products, Inc. ... 224
● Henderson-Hazel Corp. ... 164
Hevi-Duty Electric Co. ... 208
Holophane Co., Inc. ... 113
Holub Ind., Inc. ... 222
● Hose-McCann Telephone Co., Inc. ... 226
● Hubbell Inc., Harvey ... 150, 151
● Huenefeld Co., The ... 27

● Ideal Industries, Inc. ... 48, 49
● International Register Co. ... 146
I-T-E Circuit Breaker Co. ... 10, 26, 62, 78
I-T-E Circuit Breaker Co., Walker Division ... 71, 159

Jet Line Gun Co. ... 180
● Johns-Manville ... 28
Jones Metal Products Co., The ... 36

Katolight Corp. ... 230
Kidde Ultrasonic & Detection Alarms Division, Walter Kidde & Co., Inc. 225
● Killark Electric Mfg. Co. ... 64, 65
● Klein & Sons, Mathias ... 200

Land Air, Inc., Subsidiary of California Eastern Aviation, Inc. ... 224
Leviton Mfg. Co. ... 204
● Lidseen of North Carolina, Inc. ... 192
Lighting Products Inc. ... 135
Lightolier, Inc. ... 22
Line Material Industries ... 118, 119
Longyear Co., E. J. ... 229

Mark & Co., Clayton ... 16, 17
McGill Manufacturing Co., Inc. ... 46
McGraw-Hill Book Co. ... 231
McPhilben Lighting Co. ... 166
● Metalcraft Products Co., Inc. ... 170
Midwest Electric Products, Inc. ... 214
Miller Co., The ... 117
● Minerallac Electric Co. ... 228
Minnesota Mining & Mfg. Co. ... 220
● Multi Electric Mfg., Inc. ... 221

● National Price Service ... 164
National Supply Co.—Tubular Products Div. ... 161
● Niagara Transformer Corp. ... 139

Okonite Co., The ... 169

● Paragon Electric Co. ... 219
Paranite Wire & Cable Div. Essex Wire Corp. ... 56, 57
Pass & Seymour, Inc. ... 202
● Phelps Dodge Copper Products Corp. ... 63
Plymouth Rubber Co., Inc. ... 196
Porcelain Products Co. ... 190
Pringle Electrical Mfg. Co. ... 162
● Progress Mfg. Co., Inc. ... 173
● P-W Industries, Inc. ... 212

Quadrangle Mfg. Co. ... 160

Ramset Fastening Inc. ... 134
Rawlplug Co., Inc., The ... 178
Republic Steel Corp. ... 142, 143
Revere Electric Mfg. Co. ... 163
Ridge Tool Co., The ... 59
RLM Standards Institute, Inc. ... 67
Rodale Mfg. Co., Inc. ... 32
Rohm & Haas Co. ... 114
● Rome Cable Div. of Alcoa ... 24, 25
Royal Electric Corp. ... 181

● S & C Electric Co. ... 72, 73
● Sierra Electric Corp. ... 218
Sola Electric Co., Div. of Basic Products Corp. ... 124
● Sorgel Electric Co. ... 152
Square D Co. ... Third Cover, 1, 29
Stampings Inc. ... 220
Standard Transformer Co. ... 186
● Steel City Electric Co. ... 23
Steel & Tubes Division ... 142, 143
Stephens Mfg. Inc., M. ... 140
Stonco Electric Products Co. ... 207
Sunbeam Lighting Co. ... 177
Sylvania Electric Products Inc. ... 38, 60, 61
144, 145
System Analyzer Corp. ... 168

● Thiel Tool & Engineering Co., Inc. ... 228
● Thomas & Betts Co., Inc. ... 42
Thompson Electric Co., The ... 213

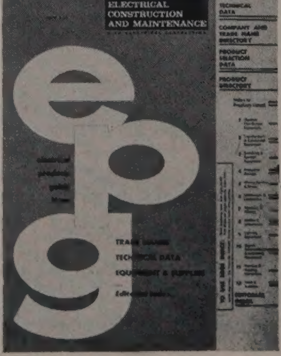
Union Carbide Plastics Co., Div. of Union Carbide Corp. ... 120
Universal Motor Co. ... 227
● U. S. Steel ... 76, 77

● Wagner Electric Corp. ... 50, 182
● Westinghouse Electric Corp.
● Pittsburgh ... 52, 53, 198, 199
Westline Products, A Div. of Western Lithograph Co. ... 226
Where To Buy ... 230
White-Rodgers Co. ... 229
Whitney Blake Co. ... 194
● Wiegand Co., Edwin L. ... 138
Winpower Mfg. Co. ... 228
● Wiremold Co., The ... 148

●

CLASSIFIED ADVERTISING
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES ... 231
NOTICES
  Legal ... 231
EQUIPMENT
  (Used or Surplus New)
  For Sale ... 231



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